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West Virginia Department of Environmental Protection

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Cabinet Secretary

September 2, 2003

Roger Rhinehart
US EPA, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Rhinehart:

This letter is to verify your receipt of the final Groundwater Investigation Steering Team "GIST" report on the chemical ammonium perfluorooctanoate [C-8] used and disposed of by DuPont at their Washington Works facility and three associated landfills (Local, Dry Run, and Letart). With receipt of this report the responsibilities as stipulated by Consent Order (GWR-2001-019) are concluded.

If you have not received this report or have any questions concerning this report please contact me at the above address or telephone number.

Sincerely,

David P. Watkins
Regulatory Programs Section Manager

AMMONIUM PERFLUOROOCTANOATE (C-8) GROUNDWATER INVESTIGATION STEERING TEAM REPORT

AUGUST 2003

CONSENT ORDER NO. GW- 2001-019

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AMMONIUM PERFLUOROOCTANOATE (C-8) GROUNDWATER INVESTIGATION STEERING TEAM REPORT

EXECUTIVE SUMMARY

A multi-media Consent Order (GWR-2001-019) was entered into between the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources-Bureau for Public Health (WVDHHR-BPH) and DuPont on November 14th, 2001.

The Consent Order identified a series of requirements to be performed by the Parties (WVDEP, WVDHHR-BPH, and DuPont) in order to determine whether there has been any impact on human health and the environment as a result of releases of ammonium perfluorooctanoate (C-8), CAS Number 3815-26-1, to the environment from DuPont operations at the Washington Works main plant and three associated landfills (Local, Dry Run, and Letart). C-8 is a material used by DuPont in its fluoroproducts manufacturing process at its Washington Works Facility's located in Washington, Wood County, West Virginia. C-8 has not been identified as a hazardous substance, hazardous waste, or otherwise specifically regulated under West Virginia or federal statute or regulation.

In accordance with Attachment A of the Consent Order, three tasks were to be performed by DuPont and evaluated by the Groundwater Investigation Steering Team (GIST). The GIST used a phased approach towards meeting these requirements.

TASK A:

Task A required Dupont to conduct a distance-phased public water supply service survey along the Ohio River on both the West Virginia and Ohio sides of the river. Subsequent to the Task A requirement, a one-mile (and possibly a two- and three-mile) radial distance of the Washington Works Facility and the Local, Letart, and Dry Run Landfills. The phased approach to the water and groundwater well use survey and sampling was intended to allow the GIST to focus efforts along potential C-8 impact transport pathways and eventually cease activities in directions where impacts were not present or where there were low concentrations.

WEST VIRGINIA PRIVATE WATER SUPPLY SOURCES:

Conclusions:

• Initial sampling within a one-mile radius of the Washington Works Facility and each of the three landfills resulted in varying levels of C-8 being found in private water sources.

• Private water sources within a one- to two-mile radius were sampled around the Washington Works Facility and the Local Landfill based on C-8 concentrations detected greater than 1.0 µg/l in the one-mile radius. No further private water sources sampling beyond the two-mile radius is necessary based on the lower concentrations detected in the one- to two-mile radius sampling area.

• No private water sources in West Virginia were found to exceed the C-8 drinking water screening level of 150 µg/l. The highest concentration detected was 10.4 µg/l.

Recommendations:

• Continued quarterly sampling of selected private water sources around the Washington Works Facility and Local and Dry Run Landfills for one year is recommended by the GIST. Annual sampling of the private water sources at the Letart Landfill is also recommended. Subsequently, the frequency of the sampling should then be re-evaluated.

OHIO PRIVATE WATER SUPPLY SOURCES:

Conclusions:

• Initial sampling within a one-mile radius of the Washington Works Facility resulting in varying levels of C-8 being found in approximately 94% of the water sources sampled.

• Private water sources within a one- to two-mile radius from the Washington Works Facility were sampled based on the levels of C-8 detected at the outer limits of the one-mile radius.

• No private water sources in Ohio were found to exceed the C-8 drinking water screening level of 150 µg/l. The highest concentration detected was 23.6 µg/l.

Recommendations:

• Continued quarterly sampling of selected water sources around the Washington Works Facility for one year is recommended by the Ohio EPA. Subsequently, the frequency of the sampling should then be re-evaluated.

WEST VIRGINIA PUBLIC WATER SUPPLY SYSTEMS:

Conclusions:

Ten public water supply systems along the Ohio River at various points up and downstream from the Washington Works Facility and Letart Landfill were sampled for C-8.

- No public water supply production wells in West Virginia were found to exceed the drinking water screening level of 150 µg/l. The highest concentration detected was 1.87 µg/l.

- The widespread distribution and low concentrations of C-8 indicate that the primary migration pathways to the public water supplies are air emissions from the Washington Works Facility and pumping-induced infiltration from the Ohio River, which receives C-8 from the National Pollutant Discharge Elimination System (NPDES) outfalls at the Washington Works Facility and the Letart Landfill.

Recommendations:

- Continued quarterly sampling at the Lubeck Public Service District (PSD), DuPont Washington Works Facility, and General Electric public water systems for two years is recommended by the GIST. Also, annual sampling of the Blennerhassett Island, Mason County PSD, and the Racine Lock and Dam Public Water System for two years is advised. Subsequently, the frequency of the sampling should then be re-evaluated.

OHIO PUBLIC WATER SUPPLY SYSTEMS:

Conclusions:

Six public water supply production wells along the Ohio River at various points up and downstream from the Washington Works Facility and the Letart Landfill were sampled for C-8.

- No public water supply production wells in Ohio were found to exceed the C-8 drinking water screening level of 150 µg/l. The highest concentration detected was 8.58 µg/l.

- The widespread distribution and the low concentrations of C-8 indicate that the primary migration pathways to the public water supplies are air emissions from the Washington Works Facility and pumping-induced infiltration from the Ohio River, which receives C-8 from NPDES outfalls at the Washington Works Facility and Letart Landfill.

Recommendations:

• Continued quarterly sampling of the Little Hocking Water Association Public Water System for two years is recommended by the GIST. Also, annual sampling of the Tuppers Plains-Chester Water District Public Water System for two years is advised. Subsequently, the frequency of the sampling should then be re-evaluated.

TASK B:

Task B required the development and implementation of a monitoring plan that would determine the extent and presence of C-8 in drinking water, groundwater, and surface water in and around the Washington Works Facility and the three landfills, and to provide a compilation of all available groundwater/surface water monitoring and hydrogeologic characterization data for each facility.

OHIO RIVER SURFACE WATER SAMPLING:

Conclusions:

• Twelve sampling locations in the Ohio River at points up to 28.6 miles upstream of the Washington Works Facility and downstream to the Letart Landfill were sampled for C-8.

• No samples collected from the Ohio River were found to exceed the C-8 drinking water screening level of 150 µg/l. The highest concentration detected was 1.04 µg/l.

Recommendations:

• No additional river sampling is recommended.

SURFACE WATER AND GROUNDWATER MONITORING:

This task included monitoring of the surface water and groundwater at the Washington Works Facility and the three landfills for four consecutive monthly events, followed by quarterly sampling thereafter.

DRY RUN LANDFILL:

Conclusions:

• C-8 is believed to be migrating, via groundwater and surface water, from the C-8-containing waste that has been disposed of within the landfill.

• Groundwater flow is toward the west and toward the Dry Run valley at this site.

• C-8 concentrations measured within the one-mile radius of the site show that some off-site migration of C-8 may have occurred.

• The Dry Run Landfill is located within eight miles of the Washington Works Facility. The transport of C-8 via air emissions from the plant could potentially be the source of the very low concentrations of C-8 detected within the one-mile radius sampling area.

• There are no known complete exposure pathways for human receptors that exceed the C-8 drinking water screening level of 150 µg/l.

Recommendations:

• Surface water and groundwater monitoring should continue at this site. The groundwater sampling should continue to be quarterly, while the outfall sampling can be either monthly or quarterly, as required by the site's NPDES permit.

• The C-8 concentrations in wells DRMW-13A and DRMW-13A should be monitored, as these wells appear to be the most vulnerable (down-gradient portion of the C-8 plume).

• The C-8 concentrations at the Dry Run leachate discharge location should be monitored.

LETART LANDFILL:

Conclusions:

• C-8 is believed to be migrating via surface water transport from the C-8 containing waste that has been disposed of within the landfill.

• Groundwater flow in the A Zone, D-E Zones, C Zone, and F Zone at the Letart Landfill is towards the Ohio River, and is away from the private water supplies in this area. Groundwater flow in the F Zone (the deepest zone) is generally believed to be towards the Ohio River and away from the private water supplies in this area; however, there may be a groundwater flow divide on the upper and northwestern side of the landfill.

• The annual C-8 loading from groundwater to the Ohio River indicates a very low concentration in the river from the landfill, and this is supported by the very low concentrations of C-8 in the Ohio River downstream of the landfill. It is possible, however, that this loading is contributing to the presence of low C-8 concentrations in some of the down river community water systems.

• Air emissions are not a viable migration pathway from the landfill because there

are no air emissions at the Letart Landfill.

• There are three complete exposure pathways for human receptors that exceed the CATT-established C-8 drinking water screening level of 150 µg/l. These are: contact with either surface water runoff (at the Cap Runoff location), leachate discharged to surface water at the toe of the Letart Landfill, and the resulting wet-weather stream that discharges into the Ohio River. However, these exposure routes are limited because of the remote location of the landfill, the very steep terrain, and the wet-weather nature of the stream. In addition, the fencing around the site limits trespasser access to the area, and the use of health and safety plans, standing operating procedures, and personal protective equipment also limits C-8 exposure for the on-site workers.

Recommendations:

• Surface water and groundwater monitoring should continue at this site. The groundwater sampling should continue to be quarterly, while the outfall sampling can be either monthly or quarterly, as required by the site's NPDES permit.

• All three of the Zone A groundwater monitoring wells (LMW-1, LMW-7, and LMW-8) should be monitored for C-8 concentrations and groundwater flow direction.

• Zone F groundwater wells LMW-2A and LMW-12 should be monitored for C-8 concentrations and groundwater flow direction.

LOCAL LANDFILL:

Conclusions:

• C-8 is believed to be migrating via surface water transport from the C-8 containing waste that has been disposed of within the landfill.

• Groundwater flow from the Local Landfill is toward the northwest at this site and toward the Ohio River valley. Flow is also towards the Washington Works Facility.

• C-8 detected within the one- and two-mile radius sampling areas near the Washington Works Facility and Local Landfill is likely to have been transported from the plant via air emissions.

• There are no known complete exposure pathways for human receptors that exceed the C-8 Assessment of Toxicity Team (CATT)-established C-8 drinking water screening level of 150 µg/l.

Recommendations:

• Surface water and groundwater monitoring should continue at this site. The groundwater sampling should continue to be semi-annually, while the outfall sampling can be either monthly or quarterly, as required by the site's NPDES permit.

• Three locations at the Local Landfill should be monitored: Outlet 101, Outlet LM1, and well LLMW-4.

WASHINGTON WORKS FACILITY:

Conclusions:

• The on-site Solid Waste Management Units (SWMUs) are believed to be the primary source of C-8 migration into the groundwater.

• Air deposition of C-8 onto the ground surface and its subsequent migration into the groundwater may also have occurred.

• No off-site migration of the groundwater is occurring, as long as DuPont's Western Well Field continues pumping.

• Some limited groundwater may migrate off-site in the northwest corner of the DuPont facility in response to the GE plant pumping their wells #3 and #4.

• Air emissions are believed to be the primary migration pathway of C-8 from the Washington Works Facility to adjacent areas in Ohio.

• Air emissions of C-8 from the Washington Works Facility are believed to be the source of C-8 detected in areas of West Virginia located adjacent to the facility and the Local Landfill.

• Air emissions of C-8 and the discharge of C-8 through the outfalls are believed to be the migration pathways of C-8 from the facility to the Ohio River, and—most likely—from the river to the public water supplies located downstream.

• Air emissions of C-8 from the plant are believed to be the source for C-8 along the Ohio River upstream of the plant.

• There are no known complete exposure pathways for human receptors that exceed the CATT-established C-8 drinking water screening level of 150 µg/l at the Washington Works Facility.

Recommendations:

• Surface water and groundwater monitoring should continue at this site. The groundwater sampling should continue to be quarterly, while the outfall sampling can be either monthly or quarterly, as required by the site's NPDES permit.

• The following groundwater monitoring wells and outfalls require further monitoring at the Washington Works Facility: RO4-MW02, PO4-MW-2, QO4-MW02, VO5-PW01, NO4-MW-01, and Outfall 005.

It is important that DuPont further investigates the high concentrations of C-8 in these wells, which are located at the Washington Works Facility adjacent to the Ohio River. DuPont has stated (in their February 2003 *Summary Report*) that C-8 is confined to a perched aquifer and that the deeper aquifer contains no C-8.

TASK C:

Task C required the determination of the vertical and horizontal extent of any and all C-8 impacted groundwater exceeding 1 µg/l. This task also included an assessment of C-8 impacted surface water and/or groundwater at the Letart Landfill and its impact on the Ohio River and nearby public water systems along the river.

GROUNDWATER MODELING:

Groundwater modeling of the Washington Works Facility and surrounding area was conducted to evaluate the groundwater flow pathways and determine the potential of C-8 migration to off-site receptors.

Conclusions:

• The Ohio River creates a groundwater divide in the Pleistocene alluvium under the river. As a result of production-well pumping at the Dupont Washington Works Facility and the neighboring GE facility, the C-8-impacted groundwater from the Washington Works Facility is not being drawn into either the Lubeck PSD municipal well field in West Virginia or the Little Hocking Water Association well field in Ohio. Some limited groundwater may migrate off-site in the northwest corner of the DuPont facility in response to GE pumping wells #3 and #4. Sources of C-8, for the Lubeck PSD and the Little Hocking Water Association, are coming from the Ohio River and dispersion by air.

Recommendation:

• The URS Diamond model should be accepted as representing real-world conditions in determining groundwater flow and contaminant transport.

INTRODUCTION

C-8 has been used by DuPont since the early 1950's in its fluoropolymer related manufacturing processes. Residues containing C-8 from the fluoropolymer manufacturing processes at the Washington Works Facility are or have been released to the air, discharged to the Ohio River, disposed of at the facility, and otherwise shipped off-site for destruction and/or disposal. DuPont also captures for recycling a portion of used C-8.

No permits issued to Dupont authorizing release of pollutants to the environment contain specific limitations on the amount of C-8 that may be released. Since as early as 1990, DuPont has performed regular, voluntary water sampling to detect the presence and level of C-8 in and around its facilities in West Virginia, and has reported the results of these samplings to WVDEP. As a result of DuPont's sampling, C-8 has been detected in varying concentrations in private and public water supplies. DuPont, by and through its use of C-8 in the fluoropolymer manufacturing process, was considered the likely source.

The federal Environmental Protection Agency (EPA), WVDEP, and WVDHHR-BPH determined that it was desirable to ascertain the source of C-8 in drinking water for persons potentially exposed to groundwater or surface waters in the area of these facilities. The EPA, WVDEP, and WVDHHR-BPH requested that DuPont submit all information and documents relating to the detection and presence of C-8 in and around these facilities. The agencies concluded that it would be of great importance to have sufficient data upon which to determine the potential exposure risk of the presence of C-8 in the environment.

Therefore, a C-8 Groundwater Investigation Steering Team (GIST) was established in the Consent Order to oversee investigations and activities that would be conducted to assess the presence and extent of C-8 in drinking water, groundwater, and surface water at and around the main plant, and the Local, Dry Run, and Letart Landfills.

The GIST was made up of a team of scientists assembled from the WVDEP, WVDHHR-BPH, EPA Region III, and DuPont. In May 2002 a Memorandum of Understanding (MOU) was signed by WVDEP, WVDHHR-PBH, and DuPont with the Ohio EPA. The MOU established guidelines for Ohio EPA's participation in the GIST due to the discovery of C-8 in Ohio public drinking water supplies.

DuPont, through an agreed-upon third party and under the supervision of the GIST, conducted the groundwater use and well survey identification and sampling of groundwater wells and other water sources (*i.e.*, springs and cisterns) within the one-mile radius of the Washington Works Facility and the three landfills. Identification and sampling of private wells was contingent upon landowner permission. Based upon concentrations of C-8 found in water sources, the GIST through the Consent Order was empowered to possibly expand the radial survey distance to include wells within a two-

or three-mile radius of the Washington Works Facility and the three landfills.

Historical data and hydrogeologic information was evaluated in order to prioritize the initial scope of work for continuing groundwater monitoring and any additional investigation activities (*e.g.* monitoring well installations) required under Task C Plume Identification.

Upon conclusion of the Tasks set forth in the Consent Order, the GIST was charged with preparing a final report with findings and conclusions regarding groundwater quality, and the extent of groundwater impacts. The final GIST report provides conclusions and makes recommendations regarding the need to conduct further work, or to take actions necessary to assure protection of groundwater quality and human health. The following report summarizes those findings, conclusions, and recommendations of the GIST in fulfillment of the Consent Order.

WEST VIRGINIA PRIVATE WATER SUPPLY SOURCES

Pursuant to Attachment A of the Consent Order, the Groundwater Use and Well Survey involved evaluating C-8 in groundwater initially within a one-mile radius from the Washington Works Facility and the three landfills (Local, Letart, and Dry Run) by sampling water from wells, cisterns, and springs. The area was expanded to a two-mile radius at the Washington Works Facility and the Local Landfill based on the initial results obtained from the one-mile radius survey and sampling.

Between March 2002 and October 2002, DuPont's third-party contractor, Potesta Associates, Inc., performed a door-to-door well survey and collected samples following protocols established by the multi-media consent order. Representatives from the WVDEP and the Wood County Health Department accompanied Potesta Associates, Inc. personnel during the initial door-to-door survey.

WASHINGTON WORKS FACILITY AND LOCAL LANDFILL:

In April 2002, DuPont submitted a report to the GIST documenting the well survey and C-8 sample results within a one-mile radial distance around the DuPont Washington Works Facility and the Local Landfill. Because of the proximity of the Local Landfill to the DuPont Washington Works Facility, groundwater wells located within the combined one-mile radius (of both sites) in West Virginia were sampled. A total of 44 samples were collected from drinking water wells, non-drinking water wells, unused wells, springs, and cisterns.

The C-8 concentration from drinking water wells ranged from 0.328 µg/l to 2.8 µg/l. The highest concentration of C-8 from the category of non-drinking water wells and unused wells was 14.3 µg/l. C-8 was detected in all wells, springs, and cisterns sampled within the one-mile radius. A total of two samples collected in the one-mile radius had concentrations of C-8 above10 µg/l. Because of the levels found in the one-mile radius of the Washington Works Facility and the Local Landfill, the private water supply sources survey was extended by the GIST to a two-mile radius. In addition, private and industrial water supplies used for drinking water were sampled on a monthly basis until the CATT drinking water screening concentration of 150 µg/l was developed.

The private water supply sources survey and C-8 sampling results within the one- to two-mile radius of the DuPont Washington Works Facility and the local landfill were submitted on August 2002 to the GIST. A total of 65 samples were collected and analyzed for C-8 including drinking water wells. The C-8 concentrations measured in drinking water wells ranged from non-detect (<0.010 µg/l) to 0.889 µg/l. The highest concentration of C-8 from non-drinking water wells or unused wells was 1.57 µg/l. A spring sample, used for drinking water, had a concentration of 1.8 µg/l. Due to measured concentrations of C-8 in the two-mile radius indicating a decreasing trend in distance from the Washington Works Facility, the GIST determined that additional samples beyond the two-mile radius were not necessary.

In summary, C-8 was detected in 100% and 79% of the private water supply sources sampled in the one- and two-mile areas, respectively. The concentrations of C-8 were lower in the two-mile radius area as compared to the one-mile radius. No private water supply sources in the one- or two-mile radius area exceeded the CATT-established C-8 drinking water screening level of 150 µg/l. The widespread distribution of C-8 in private water supply sources, combined with the lack of groundwater flow to this area from the Washington Works Facility and the Local Landfill facilities, indicates that air emissions may be the primary migration pathway of C-8 from the facility to adjacent areas in West Virginia.

RECOMMENDATIONS:

Under the Consent Order, a significant number of private water supply samples have been collected that document the extent and current concentrations of C-8 in groundwater within the one- and two-mile radial areas. Most locations have been sampled at least once. It is unknown whether the concentrations detected in groundwater are the result of historic air deposition or result of air deposition in the last couple of years. Therefore, the GIST recommends that DuPont collect additional samples from the following selective locations to evaluate the current trend of C-8 concentrations in private water sources. Additional samples should be collected from the following sample locations, with the owner's permission:

- Drinking water wells with detected levels of C-8,
- Drinking water springs with detected levels of C-8,
- Non-drinking water wells with detected levels of C-8,
- Springs and cisterns with detected levels of C-8, and
- Wells or springs used for cattle above 5 µg/l (total 1).

The GIST recommends selecting ten of these locations, with at least one or more from each category, for quarterly sampling for one year. Subsequently, the frequency of the sampling should then be re-evaluated.

LETART LANDFILL:

In April 2002, DuPont submitted a report to the GIST documenting the well survey and C-8 sampling results within the one-mile radial area around Letart Landfill. A total of 30 samples were collected from drinking water wells, non-drinking water wells, unused wells, springs, and cisterns. The C-8 concentration from drinking water wells ranged from non-detect (<0.01 µg/l) to 0.139 µg/l. The highest concentration of C-8 from the category of non-drinking water wells was 0.636 µg/l, from Brinker Run, which was named for sampling purposes" Route 33 Unnamed Stream." This concentration may be the result of surface water infiltration from the Letart Landfill into Brinker Run. Due to the low C-8 concentrations found at the Letart Landfill, and in the private water supply sources the survey was not extended by the GIST to a two-mile radial area.

In summary, C-8 was detected in 6% of the private water supply sources sampled in the one-mile radial area. No private water supply sources samples exceeded the CATT-established C-8 drinking water screening level of 150 µg/l.

RECOMMENDATIONS:

Under the Consent Order, a significant number of private water supply samples were collected that document the extent and current concentrations of C-8 in private water supplies within a one-mile radius of the Letart Landfill.

Each location was sampled at least once. The C-8 concentrations measured in all Letart Landfill one-mile radius samples were non detect or not quantifiable, except for one sample collected from a well used for drinking water that had a concentration of 0.139 µg/l and one sample collected from an unused well that had a concentration of 0.639 µg/l. The GIST required that the drinking water well with the C-8 concentration of 0.139 µg/l be resampled. The resident refused to have the well resampled.

Each location has thus been sampled a single time, and there is no clear trend as to whether the concentrations of C-8 detected in groundwater are increasing or decreasing. Therefore, the GIST is recommending that DuPont collect yearly samples from the (b) (6)(b) (6) and the (b) (6)(b) (6) private water supply sources, contingent upon permission of the well-owners, to evaluate the trend of C-8 concentrations in the private drinking water supplies. This sampling frequency should then be re-evaluated.

DRY RUN LANDFILL:

In April 2002, DuPont submitted a report to the GIST documenting the well survey and C-8 sampling results within the one-mile radius area around Dry Run Landfill. A total of 53 samples were collected from drinking water wells, non-drinking water wells, unused wells, springs, and cisterns. The C-8 concentrations from drinking water wells ranged from non-detect (<0.01 µg/l) to 0.422 µg/l. The highest concentration of C-8 from the category of non-drinking water wells and unused wells was 0.839 µg/l. Due to the low levels of C-8 found at the Dry Run Landfill, the private water supply survey was not extended by the GIST to a two-mile radial area.

In summary, C-8 was detected in 60% of the private water supply samples collected in the one-mile area. No private water samples in the one-mile radius exceeded the CATT-established C-8 drinking water screening level of 150 µg/l. The widespread distribution of C-8 in private water supply supplies within the one-mile radial area of Dry Run Landfill indicates that air emissions may be the primary migration pathway for C-8 from the Washington Works Facility. This assumption was made due to the lack of groundwater flow into these areas.

RECOMMENDATIONS:

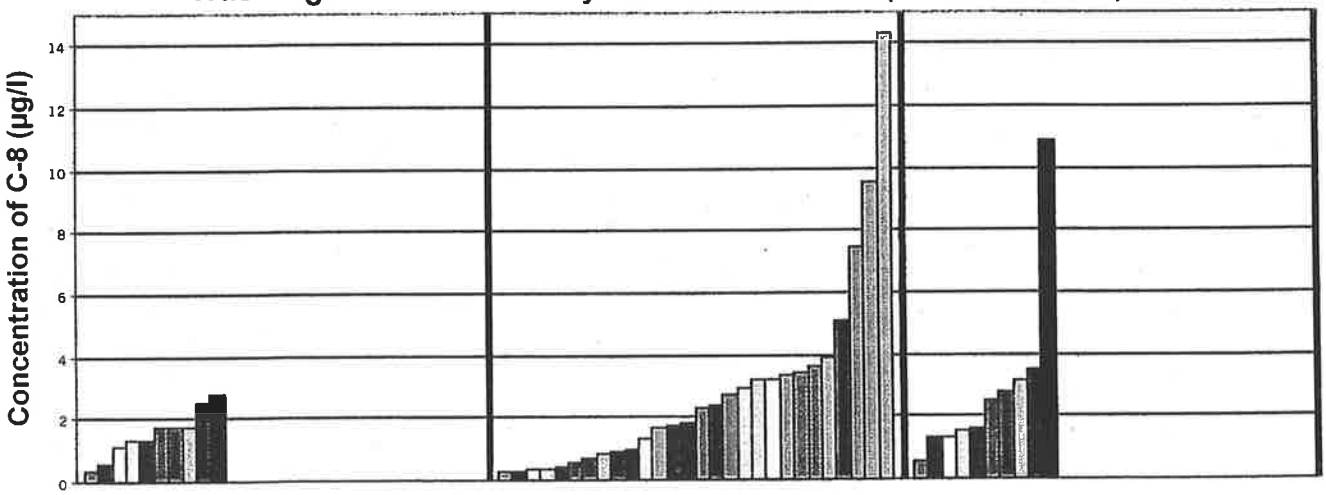
Under the Consent Order, a significant number of private water supply samples

have been collected that document the extent and current concentrations of C-8 in groundwater within a one-mile radius of the Dry Run Landfill. It is unknown whether the concentrations detected in the groundwater are the result of historic or recent air emission sampled at each locations only once. Therefore, the GIST recommends that DuPont collect additional samples from selective locations to evaluate the trend of C-8 concentrations. The criteria to select repeat sample locations, with the owners' permission, may include:

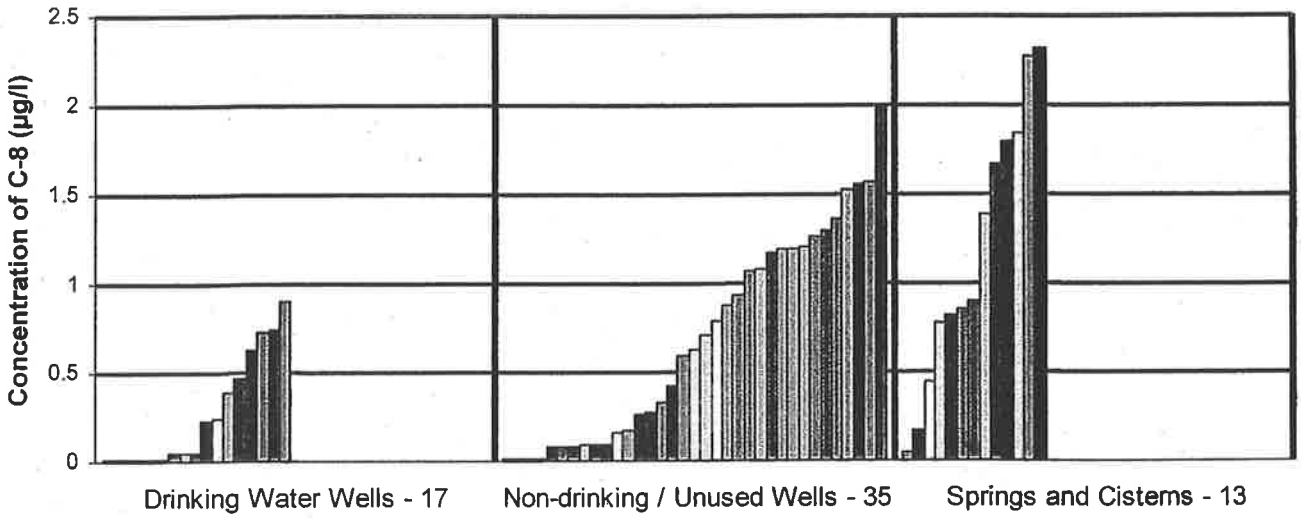
- Drinking water wells with detectable levels of C-8,
- Drinking water springs with detectable levels of C-8, and
- Springs and cisterns with detectable levels of C-8.

The WVDHHR-BPH and WVDEP recommend selecting ten, with at least one or more from each category, of these locations for quarterly sampling for one year. The sample frequency for sampling private water supplies should then be re-evaluated.

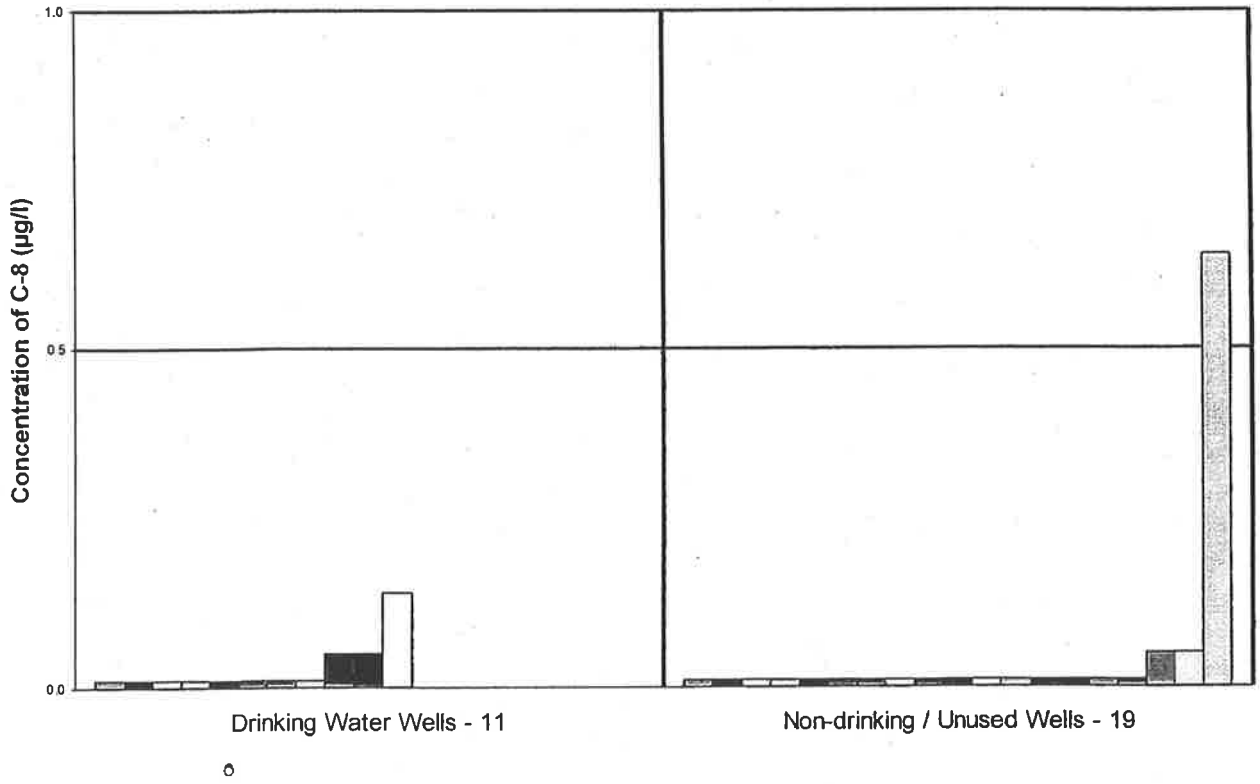
Summary of C-8 Results in Private Water Supply Systems at the Washington Works Facility and Local Landfill (1 Mile Radius)



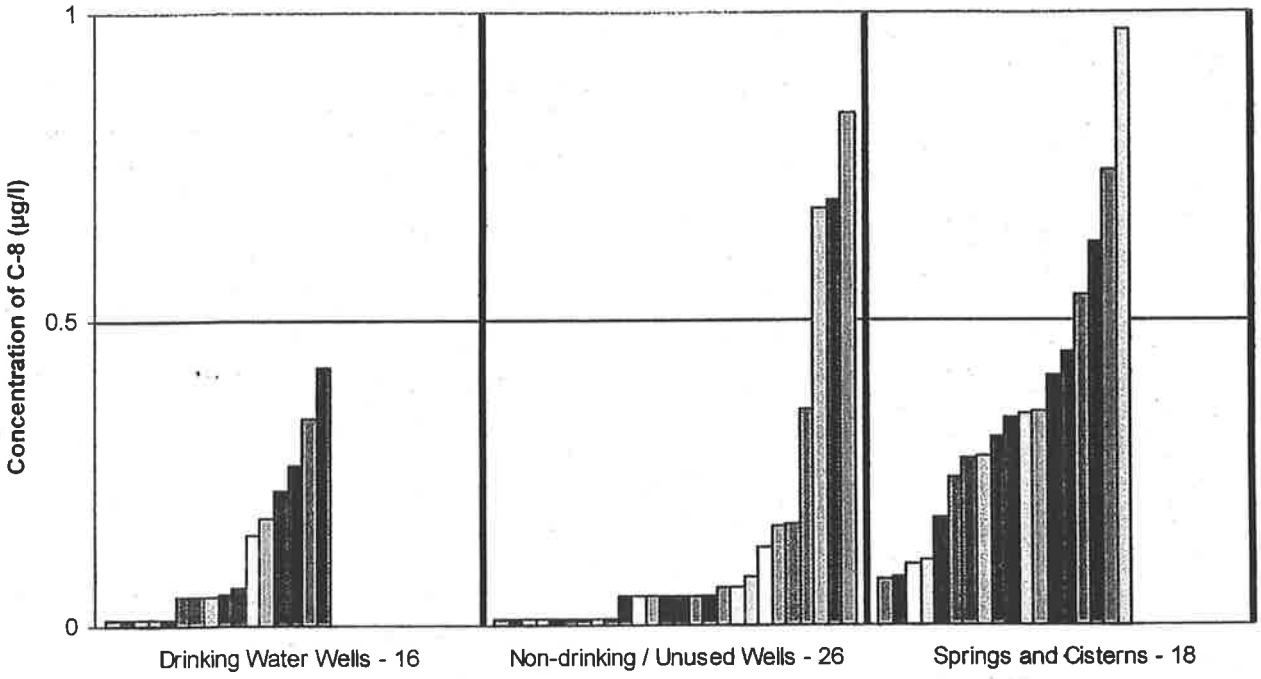
Summary of C-8 Results in Private Water Supply Systems at the Washington Works Facility and Local Landfill (2 Mile Radius)



Summary of C-8 Results in Private Water Supply Systems at the Letart Landfill (1 Mile Radius)



Summary of C-8 Results in Private Water Supply Systems at the Dry Run Landfill (1 Mile Radius)



OHIO PRIVATE WATER SUPPLY SOURCES

As a result of C-8 being detected in the Little Hocking Public Water Supply in December 2001, Ohio EPA and DuPont, in addition to the work being performed under the West Virginia Consent Order, agreed to expand the private water supply sources water use survey and C-8 sampling into Ohio within a one-mile radial distance from the Washington Works Facility. Between March and June of 2002, Potesta Associates, Inc. personnel performed a door-to-door well survey and collected samples from private water supply wells, springs, and cisterns. The samples were collected following the protocols established by the multi-media Consent Order between DuPont, the WVDEP, and the WVDHHR-BPH. Representatives from the Washington County Health Department, Ohio Department of Health, or the Ohio EPA accompanied Potesta Associates, Inc.'s personnel during the initial door-to-door well survey.

In August 2002, DuPont submitted a report to the GIST and Ohio EPA documenting the well survey and C-8 sample results within the one-mile radial area. A total of 69 samples were collected from drinking water wells, non-drinking water wells, unused wells, springs, and cisterns. The C-8 concentrations measured for drinking water wells ranged from non detect (<0.01 µg/l) to 8.59 µg/l, while a single spring used for drinking water was 1.29 µg/l. The highest concentration of C-8 from the category of non-drinking water wells and unused wells was 16.9 µg/l. C-8 was detected in all the springs and cisterns sampled within the one-mile radius, including a concentration of 23.6 µg/l in a spring used for livestock. Overall, a total of nine samples collected in the one-mile radius had concentrations of C-8 above 10 µg/l. Because some of these higher concentrations of C-8 were detected at the outer limit of the one-mile radius, DuPont agreed to expand the sampling effort in Ohio to two miles from the Washington Works Facility.

The private water supply survey and C-8 sampling within the one- to two-mile radius of the facility were completed in September of 2002. The results were documented in a report submitted by DuPont to the GIST and Ohio EPA in December 2002. A total of 63 samples were collected and analyzed for C-8, including 50 drinking water wells. The C-8 concentrations measured in drinking water wells ranged from non detect (<0.01 µg/l) to 6.5 µg/l. No cisterns and springs sampled in the two-mile radius were used for drinking water. The highest concentration of C-8 from non-drinking water wells or unused wells was 8.68 µg/l. One spring sampled for C-8 had a concentration of 3.02 µg/l. Overall, no concentrations of C-8 were detected above 10 µg/l within the one- to two-mile radius.

In summary, C-8 was detected in approximately 94% and 77% of the private water supply samples collected in the one- and two-mile areas, respectively. In general, the concentrations of C-8 are lower in the two-mile radius area as compared to the one-mile radius. Because measured concentrations in the two-mile radius indicated a decreasing trend in distance from the Washington Works Facility, the Ohio EPA and DuPont determined that additional sampling beyond the two-mile radius was not necessary. No private water supply samples in the one- or two-mile radius exceeded

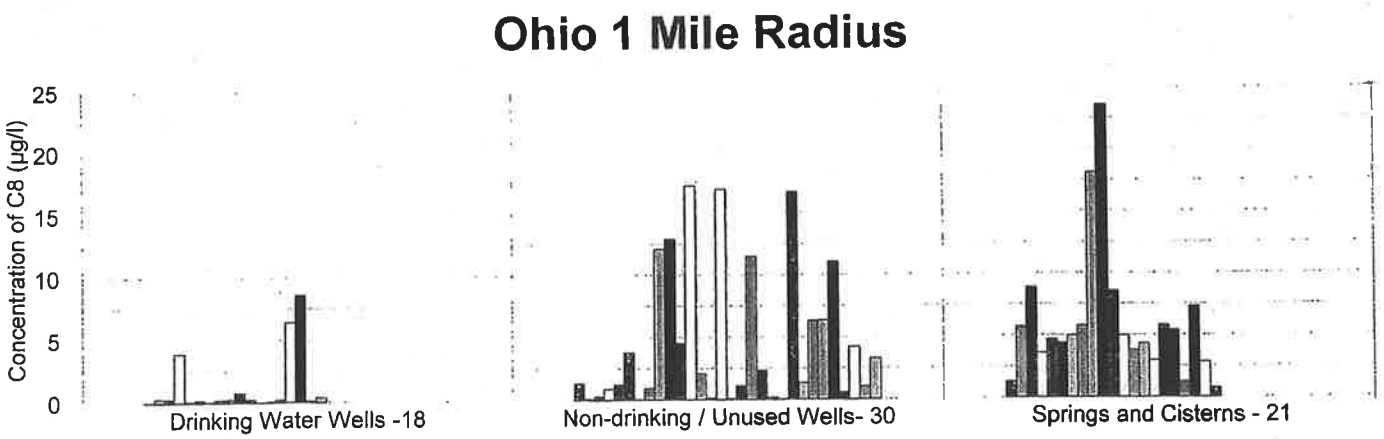
the CATT-established C-8 drinking water screening level of 150 µg/l. The wide spread distribution of C-8 in private water sources, along with the lack of a groundwater pathway, indicates that air emissions are the primary migration pathway of C-8 from the Washington Works Facility to adjacent areas in Ohio.

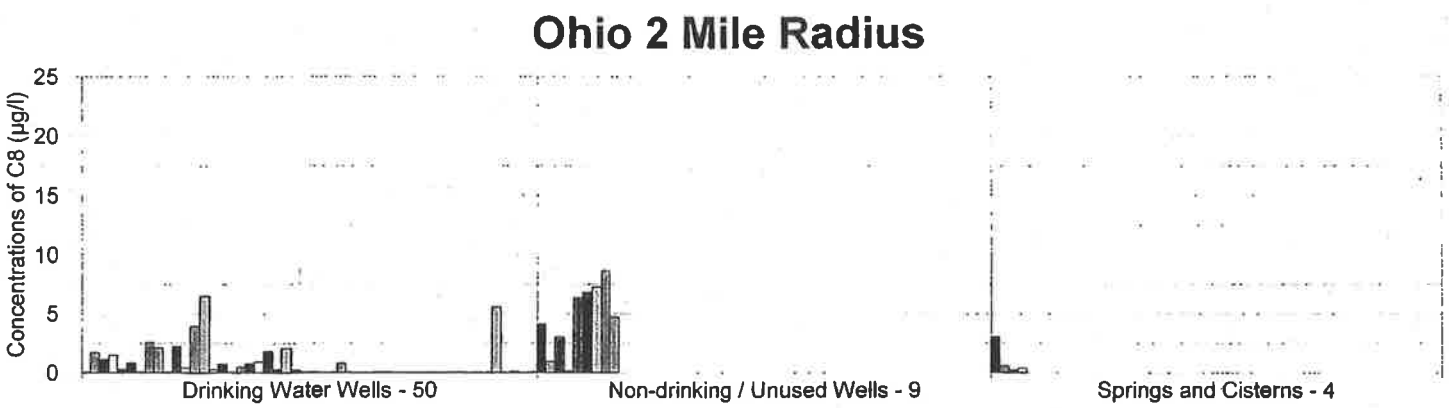
RECOMMENDATIONS:

At the request of the Ohio EPA, DuPont has collected a significant number of private water supply samples in Ohio that document the extent and current concentration of C-8 in groundwater, springs, and cisterns, within two miles of their Washington Works Facility. Each location has been sampled once, and it is currently unclear as to whether the concentrations detected in private water sources are reflective of historic air emissions or air emissions in the last couple of years. Therefore, to evaluate the trend of C-8 concentrations, the Ohio EPA recommends that DuPont collect additional samples with the owners' permission from the following categories of private water sources:

- Drinking water wells with detectable levels of C-8,
- Drinking water spring with detectable levels of C-8,
- Non-drinking water wells with detectable levels of C-8, and
- Springs and cisterns with detectable levels of C-8.

The Ohio EPA recommends selecting at least ten locations with one of more samples from each category for quarterly sampling for one year. Subsequently, the frequency of sampling will be re-evaluated by the Ohio EPA and DuPont.




Ohio 2 Mile Radius
Concentrations of C8 (µg/l)
25
20
15
10
5
0
Drinking Water Wells - 50
Non-drinking / Unused Wells - 9
Springs and Cisterns - 4

WEST VIRGINIA PUBLIC WATER SUPPLY SOURCES

Public Water Supply Sources (PWSSs) in West Virginia along the Ohio River were sampled at various points upstream and downstream of the DuPont Washington Works Facility pursuant to the Consent Order. Initial sampling of PWSSs within a one-mile upstream and ten miles downstream of the facility began in December 2001. Based on the C-8 concentrations measured, the sample area was expanded to include PWSs located as far as seven miles upstream of the facility and 54 miles downstream. Sampling efforts between January 2002 to March 2003 resulted in the following findings:

Public Water System	*River Miles from Washington Works*	*Sampling Dates*	*Well Field Results (C-8 µg/l)*	*Distribution System Results (C-8 µg/l)*
Parkersburg Water Department	-7	Mar and Apr 2002	Well #1: 0.0686 to 0.0746 Well #2: ND Well #3: ND Well #4: ND Well #5: ND	NQ
Blennerhassett Island State Park	-1	Jan 2002	Well #1: 0.165	Not tested
DuPont Washington Works Facility	0	Jan 2002 Mar 2003	AM07-PW01: NQ to 0.335 AO08-PW01: 0.308 to 0.499 AX13-PW01: 0.721 to 1.42	Not tested
General Electric	1.5	Jan, Feb, and Apr 2002	Well #3: 1.75 to 1.87	Not tested
Lubeck PSD	4.5	Jan 2002 to Feb 2003	Well A: 0.683 to 0.938 Well B: 0.443 to 0.61 Well C: 0.398 to 0.592 Well D: 0.397 to 0.758 Well E: 0.332 to 1.21 Well F: 0.283 to 1.04	0.6 to 0.69
Bellville Hydro Electric Recreation	14	Jan 2002	Not tested	ND
Ravenswood Municipal Water Works	31	Mar 2002	Well #1: ND Well #2: ND Well #3: ND Well #4: ND Well #5: ND	NQ
Mason County PSD—Letart	45	Jan, Mar, and Apr 2002	Well #1: NQ Well #2: 0.0618 to 0.0838 Well #3: 0.063 to 0.102	Not tested

Racine Locks and Dam	48	Jan 2002	Not tested	0.518
New Haven Water Department	54	Apr 2002	Well #1: NQ	ND

* A negative stream mile value refers to a location upstream from the Washington Works Facility. A positive number refers to a location downstream from that facility.
** ND refers to a "Non Detect" concentration that is at or below the laboratory's minimum detection limit. The listed concentration can vary by instrument and time; however, the Non Detect concentration for C-8 for this period of time is 0.01 µg/l.
*** NQ refers to "Not Quantifiable." It is a concentration that is below the laboratory's minimum detection limit and is therefore below the level of quantification. The Not Quantifiable concentration for C-8 for this period of time is 0.05 µg/l.

Upon completion of the C-8 Assessment of Toxicity Team (CATT) study establishing a drinking water screening level of 150 µg/l for C-8, sampling efforts were discontinued for General Electric, Parkersburg Water Department, Blennerhassett Island State Park, Bellville Hydro Electric Recreation Plant, Ravenswood Municipal, Mason County PSD—Letart, Racine Locks and Dam, and New Haven Water Department based on the measured low concentrations. Sampling was continued at the DuPont Washington Works Facility and Lubeck PSD on a quarterly basis to continue to evaluate trends in C-8 concentrations.

CONCLUSIONS:

The completion of the groundwater studies and sampling efforts performed as a part of the C-8 GIST study have resulted in the following conclusions regarding the source of C-8 in the West Virginia PWSSs:

• *Parkersburg Water Department and Blennerhassett Island State Park:* It is believed that the C-8 levels are transported from the DuPont Washington Works Facility via air emissions. Please note that C-8 transported in air emissions and deposited on surfaces is likely to be mobilized by precipitation and migrate via water transport to surface and/or groundwater.

• *DuPont Washington PSD:* It is believed that the C-8 levels are transported via air emissions, and from groundwater migration from C-8-containing materials in the on-site Solid Waste Management Units at the Washington Works Facility.

• *General Electric:* It is believed that the C-8 levels are transported from the DuPont Washington Works Facility via air emissions associated with the infiltration of precipitation or from production-well-induced recharge from the Ohio River impacted with wastewater discharges from the DuPont Washington Works Facility.

• *Lubeck PSD:* It is believed that the C-8 levels are associated with pumping-induced recharge of surface water from the DuPont Washington Works Facility's wastewater discharges to the Ohio River and possibly via air deposition.

• *Mason County PSD—Letart:* It is believed that the C-8 levels are derived from pumping-induced recharge of surface water from DuPont Washington Works Facility's wastewater discharges to the Ohio River.

• *Racine Locks and Dam:* It is believed that the C-8 levels are derived by pumping-induced recharge of surface water from the DuPont Washington Works Facility and/or the Letart Landfill leachate discharges to the Ohio River.

RECOMMENDATIONS:

Considering this data, it is the GIST's recommendation that DuPont continue the following for the PWSSs:

• *Lubeck PSD, DuPont Washington Works Facility, and General Electric:* Quarterly sampling of wells for two years to ensure that C-8 levels are being maintained or reduced. Conduct a limited field investigation to determine the extent and concentration of C-8 in soil at the Lubeck PSD in the vicinity of their production wells. When the soil sample results are available and the data is evaluated, the GIST will determine what additional sampling activities are necessary to complete the investigation. DuPont will submit a report documenting the sampling investigation and the C-8 results to the GIST when the results are finalized. After two years, the sampling program will be re-evaluated.

• *Blennerhassett Island State Park and Mason County PSD—Letart:* Annual sampling for a two-year period to ensure C-8 levels are being maintained or reduced. After two years, the sampling program will be re-evaluated.

• *Racine Lock and Dam:* Annual sampling for a two-year period to evaluate levels of C-8 due to the upstream proximity of the Letart Landfill, and to ensure that C-8 levels are being maintained or reduced. After two years, the sampling program will be re-evaluated.

• *Parkersburg Water Department, Bellville Hydro Electric Recreation Plant, Ravenswood Municipal Water Works, and New Haven Water Department:* No further action is deemed necessary at this time.

OHIO PUBLIC WATER SUPPLY SOURCES

Task A of the GIST Team Objectives and Efforts required DuPont to perform sampling of the public water supply sources along the Ohio River. As a result, the well field for the Little Hocking Water Association Public Water System was sampled for C-8 in December, 2001. The sampling results within the well field and subsequent monitoring allowed the GIST to expand the area of monitoring to include public water systems five miles up and 57 miles down the river from the Washington Works Facility. Sampling efforts between December 2001 to February 2003 have resulted in the following findings:

Public Water System	*River Miles from Washington Works*	*Sampling Dates*	*Well Field Results (C-8 µg/l)*	*Distribution System Results (C-8 µg/l)*
Little Hocking Water Association	- 0.5	Dec 2001 Jan, Feb, Mar, Apr, Aug, and Oct 2002 Feb 2003	Well #1: 1.82 to 3.65 Well #2: 2.07 to 4.26 Well #3: 0.42 to 0.952 Well #5: 5.69 to 8.58	1.82 to 4.29
City of Belpre	- 4.6	Feb, Mar, and Apr 2002	Well #1: 0.0995 to 0.13 Well #2: NQ Well #3: 0.12 to 0.141 Well #4: 0.101 to 0.133 Well #5: 0.103 to 0.111	0.081 to 0.12
Tuppers Plains/ Chester Water District	14.15	Feb, Mar, Apr, Jul, and Oct 2002 Feb 2003	Well #1: 0.486 to 0.726 Well #2: 0.235 to 0.417 Well #3: ND to NQ Well #4: ND to 0.076 Well #5: 0.201 to 0.297 Well #6: 0.433 to 0.649	0.24 to 0.363
Village of Racine	51.15	Mar 2002	Well #1: ND Well #2: ND Well #3: ND	ND
Village of Syracuse	56.9	Mar and Apr 2002	North Well: 0.208 - 0.491 South Well: ND	ND
Village of Pomeroy	56.9	Mar and Apr 2002	Well #1: ND Well #2: ND to 0.06 Well #4: 0.071 to 0.085	0.063 to 0.066

* A negative stream mile value refers to a location upstream from the Washington Works Facility. A positive number refers to a location downstream from that facility.

** ND refers to a "Non Detect" concentration that is at or below the laboratory's minimum detection limit. The listed concentration can vary by instrument and time; however, the Non Detect concentration for C-8 for this period of time is 0.01 µg/l.

*** NQ refers to "Not Quantifiable." It is a concentration that is below the laboratory's minimum detection limit and is therefore below the level of quantification. The Not Quantifiable concentration for C-8 for this period of time is 0.05 µg/l.

Upon completion of the CATT study in which a drinking water screening level of 150 µg/l for C-8 was established, sampling efforts were discontinued for the City of Belpre and the Villages of Racine, Syracuse, and Pomeroy. However, quarterly sampling was continued for the Little Hocking Water Association and the Tuppers Plains Water Systems in order to further evaluate C-8 concentration trends.

CONCLUSIONS:

The completion of the groundwater modeling and sampling efforts performed as part of the GIST study have resulted in the following conclusions being drawn concerning the source of C-8 contamination in Ohio public water systems:

- *Little Hocking:* Mainly air deposition from Washington Works Facility's stack discharges; however, pumping-induced recharge of surface water contamination from Washington Works Facility wastewater discharges to the Ohio River may have also contributed.

- *Belpre:* Air deposition from Washington Works Facility's stack discharges.

- *Tuppers Plains:* Pumping-induced recharge of surface water contamination from Washington Works Facility wastewater discharges to the Ohio River.

- *Village of Racine:* No discernible contamination.

- *Syracuse and Pomeroy:* Pumping-induced recharge of surface water contamination from the Washington Works Facility and/or the Letart Landfill leachate discharges to the Ohio River.

Considering the public water system data, and the elevated levels of C-8 noted in the Test Well 4 Investigation (see below), the GIST recommends that DuPont continue quarterly sampling of both the production wells and entry point for the Little Hocking Water Association public water system for two years. Also, annual sampling for the Tuppers Plains Water System (production wells and entry point) to ensure continued reduction of C-8 is advised. At this time, no further action is deemed necessary for the Villages of Belpre, Racine, Syracuse, or Pomeroy. After two years, the sampling frequency will be re-evaluated.

LITTLE HOCKING WATER ASSOCIATION WELL FIELD INVESTIGATION:

In addition to sampling Little Hocking Water Association's production wells, DuPont has periodically sampled ten test wells (*i.e.*, monitoring wells) within the Little Hocking Water Association well field. The concentration of C-8 is less than 2 µg/l in most of these test wells; however, a few wells exceeded 4 µg/l. In one test well, TW-4, the concentration of C-8 was measured at 37.1 µg/l in January of 2002. Subsequent sampling of TW-4 indicates generally decreasing concentrations of C-8 at 33.3 µg/l

(March 2002), 28.7 µg/l (April 2002), 12.3 µg/l (August 2002), and 14.5 µg/l (October 2002). However, in February 2003, the concentration in well TW-4 rose to 22.5 µg/l, indicating possible seasonal effects on this well.

At the request of the Ohio EPA, DuPont conducted a field investigation in the Little Hocking Water Association Well Field between August 19th and August 30th, 2002. The purpose of this investigation was to determine the extent and concentration of C-8 in soil and groundwater in the vicinity of test well TW-4. Groundwater sample results collected during this investigation ranged from non detect (<0.01 µg/l) to 78.0 µg/l of C-8. The highest C-8 concentration detected in soil from the well field is 170 µg/kg. A report documenting the results of the investigation was submitted by DuPont to the Ohio EPA and GIST in April of 2003. Once an evaluation of this report is complete, the Ohio EPA and DuPont will determine what additional activities are necessary to compete the investigation.

OHIO RIVER SAMPLING

Ohio River sampling activities were conducted to determine the concentrations and extent of C-8 in the Ohio River. Samples were collected from 12 river transects and 19 locations, and multiple depths were sampled at many of the locations.

The most distant river sampling locations were approximately 28 miles upstream and 46 miles downstream from the DuPont Washington Works Facility to determine background levels of C-8. Samples were collected adjacent to and below the DuPont Plant to determine the concentrations of C-8 in the river. The final part of the river sampling was adjacent to the Letart Landfill to determine if concentrations of C-8 were present there.

At the end of the Ohio River sampling, 49 water samples were taken, with the following results:

Transect Number	*River Mile*	*Number of across-river samples*	*Depths*	*Number of Samples collected*	*Average C-8 Concentration (µg/l)*
1	161.7	1	dip and mid-column	2	<0.01
2	179.2	1	dip and mid-column	2	<0.01
3	185.8	1	dip, mid-column, and bottom	3	<0.01
4	189.9	3	dip, mid-column, and bottom	9	<0.01
	190.3	**Washington Works Plant outfalls**			
5	190.4	3	dip, mid-column, and bottom	10 *	<0.01
6	191.0	3	dip, mid-column, and bottom	9	<0.01
7	192.7	2	dip, mid-column, and bottom	7 *	0.1167
8	194.0	1	dip and mid-column	2	1.0445
9	201.2	1	dip and mid-column	2	0.295
10	209.3	1	dip and mid-column	2	0.2375
11	236.3	1	dip and mid-column	2	0.105
	236.3	**Letart Landfill**			
12	236.5	1	dip and mid-column	3 *	0.10755

* includes a duplicate sample.

CONCLUSIONS:

No river sample exceeded the CATT-established C-8 drinking water screening level of 150 µg/l for any of the Ohio River samples. No additional river sampling is thus required as a part of the Consent Order; however, sampling should continue as part of the Washington Works Facility and Letart Landfill NPDES outfall monitoring.

SURFACE WATER AND GROUNDWATER MONITORING

It should be noted that site location maps, top-of-groundwater maps, and site geological maps are located in Appendix A, and that a complete set of groundwater data (in both table and graph form) is located in Appendix B. These data included with this final GIST report ends with the March 2003 sampling. The hydrological information is from the February 2003 *Summary Report*.

It should also be noted that the data displayed here (both historical and recent) have been generated using several different analytical methods. Prior to 1991, DuPont performed the C-8 analysis at the DuPont Experimental Station in Wilmington, Delaware. In 1991, when the Resource Conservation and Recovery Act (RCRA) Verification Investigation was conducted at the Washington Works plant, the analysis was contracted to the CH_2MHill Laboratory in Montgomery, Alabama. Both of these laboratories used a Gas Chromatography-Electron Capture Detected-based analytical methods with detection limits for C-8 that ranged from 0.1 to 1.0 µg/l. CH_2MHill conducted the C-8 analysis into the fall of 1998 when the laboratory ceased operation. At that time, the analytical work was transferred to Lancaster Laboratories, in Lancaster, Pennsylvania. DuPont continued to use this facility until October 2001, when development and testing was completed on a new analytical method utilized by Exygen Research, Inc., located in State College, Pennsylvania. This method uses a Liquid Chromatography-Tandem Mass Spectrometry. DuPont adopted the regular use of this method in November of 2001.

HISTORICAL WORK:

Before any assessment could be made of the groundwater and surface water at the four DuPont locations, a summary of the historical data was compiled. This was submitted by DuPont in January of 2002 in the document, *Compilation of Historical C-8 Data, DuPont Washington Works Facility, Main Plant, and Landfills*. This report included a brief historical, geological, and hydrogeological overview of the four sites (Washington Works Facility, Local Landfill, Dry Run Landfill, and Letart Landfill), and identified three data gaps: the need for additional groundwater monitoring wells, continued refinement of the groundwater model at the main plant, and the need to evaluate the Ohio River surface water.

This report also included location maps for the four sites, multiple geological cross-sections, four top-of-groundwater maps for each facility, and construction details for the groundwater monitoring wells. Many of the locations were sampled only once; however, samples had been collected from other locations on as many as 17 occasions. The information submitted on the four sites' historical sampling locations was as follows:

Facility	*Outfalls Sampled*	*Other Surface Water Locations Sampled*	*Groundwater Monitoring Wells Sampled*	*On-Site Drinking Water Locations Sampled*
Washington Works	2	2	62	4
Local Landfill	6	2	4	0
Dry Run Landfill	1	5	9	0
Letart Landfill	2	6	Zone A: 3 Zone B: 0 Zone C: 1 Zone D-E: 3 Zone: F: 4	0

To satisfy Task B of the GIST requirements, regular surface water and groundwater monitoring for C-8 then began in December of 2001. At first the groundwater sampling was monthly; however, this interval was modified to quarterly once the initial four sampling events were conducted. The surface water was (and still is) sampled each month. To date, including the historical data, the four DuPont sites have been sampled for C-8 for the following number of locations and occasions:

Facility	*Water Type*	*Maximum Number of Sample points*	*Maximum Number of occasions*
Washington Works	Surface	6	26
	Groundwater	20	19
Local Landfill	Surface	6	23
	Groundwater Zone A	4	13
	Groundwater Zone B	1	2
	Groundwater Zone C	3	2
	Groundwater Zone D	1	2
Dry Run Landfill	Surface	8	22
	Groundwater Zone A	3	18
	Groundwater Zone B	12	18
	Groundwater Zone C	1	2
Letart Landfill	Surface	6	25
	Groundwater Zone A	3	21
	Groundwater Zone B	0	0
	Groundwater Zone C	1	10

	Groundwater Zone D-E	5	13
	Groundwater Zone F	8	25

To satisfy Task C of the GIST requirements, it was also recognized that all of the four DuPont locations required additional groundwater monitoring wells. The following wells were added in August of 2002:

Number	*Type*	*Maximum depth*	*Drilling rig*	*Diameter*	*Screen length*
Washington Works Facility					
Three	Bedrock	about 100 feet	Rotosonic	2-inch	20-foot
Local Landfill					
Four	Overburden		Hollow-stem auger	2-inch	5 to 10 feet
Four	Bedrock	about 65 feet	Air rotary	2-inch	20-foot
Letart Landfill					
Two	Zone A	about 40 feet	Air rotary	2-inch	20-foot
Four	Zone F	about 155 feet	Air rotary	2-inch	20-foot
Dry Run Landfill					
Six	Overburden		Hollow-stem auger	2-inch	5 to 10 feet
Six	Bedrock	about 175 feet	Air rotary	2-inch	2-foot

These new wells, first sampled in October 2002, fill in missing gaps in the groundwater well fields. They provide a complete encirclement of the four DuPont locations, and should identify any C-8 groundwater plumes migrating from any of the four sites.

RESULTS AND CONCLUSIONS:

DRY RUN LANDFILL:

The Dry Run Landfill is located west of the town of Lubeck, on the headwaters of Dry Run in southwestern Wood County. The site is about eight miles southwest of the Washington Works Facility and the Local Landfill, at 39° 11' 07" North Latitude and 81° 41' 18" West Longitude. Dry Run begins at the toe of the landfill and flows to the northwest. It is a tributary of the North Fork of Lee's Creek, which flows into the Ohio River. The landfill is situated on the dissected Appalachian Plateau, and is underlain by the sandstones and shales of the Dunkard Group, which are of late Pennsylvanian or Permian age. The Dry Run Landfill began operation in 1986, and the central portion is

still active and operates under WV-NPDES Permit No. WV0076244. The upper (southeastern) portion of the landfill is closed and covered with a soil and vegetative cover. The lower (northwestern) portion also closed and is covered by an engineered-landfill cap.

The Dry Run Landfill is about 17 acres in size, and is approximately 690 feet wide and 1500 feet long, with an elevation rise of about 250 feet. It is oriented in a southeast and northwest direction, and is constructed in an old, v-shaped valley above Dry Run. Physically, the site is a long grassy slope of fill material surrounded (and situated on) the small valley's native rock and soil. The site borders no highways, residential, or industrial areas. In the late 1980s, waste sludge materials from an anaerobic digestion pond (from the main plant) was placed in the upper, southeastern side of the landfill.

Geologically, the bedrock beneath the landfill is comprised of individual layers of shale, silty clay, and sandstone and siltstone. Within this sequence the three dominant aquifers are nearly continuous sandstone and siltstone. These have been labeled by DuPont—beginning with the October 2002 groundwater monitoring report—as Zone A, Zone B, and Zone C, with Zone C being the deepest. Zone B is considered the main groundwater zone, and has eleven wells screened through it—five of these wells are newly constructed and have only been sampled on one occasion. Zone A has three wells screened within it, and Zone C has only one well.

The Zone A groundwater flows to the west-northwest, and has a gradient of 0.055 vertical feet per horizontal foot. The zone varies in depth between zero (to the northwest) and 200 feet deep (to the southeast). It is between 25 and 35 feet thick. The C-8 plume, based on three wells, appears to be moving to the west-northwest and down the axis of Dry Run.

Of the three Zone A groundwater monitoring wells, one—located northeast of the Dry Run Valley—has consistently contained concentrations below 1 µg/l. A second well, located to the southwest of the valley, contains concentrations of between 0.2 and 5 µg/l. The third well, DRMW-13, has contained the highest concentrations of C-8, ranging from 3.6 to 20.9 µg/l. This well is located in the middle of Zone A and the Dry Run valley.

The Zone B groundwater flow appears to be moving in an arc that varies between a northwestern direction in the upper southeastern portion of the site, and in a western direction in the lower western part of the site. The zone is about ten feet thick with a gradient between 0.006 and 0.023 vertical feet per horizontal foot. Zone B varies in depth from between 220 feet deep under the southeastern portion of the site to just a few feet below the surface at the toe of the landfill. It may be breached by the Dry Run surface stream northwest of the landfill. All of the wells surrounding Zone B were sampled in October 2002. Only six wells in the down-gradient western part of the landfill contained detectable concentrations of C-8. The well which consistently contains the highest concentrations of C-8 is well DRMW-13A, located directly in the Dry Run Valley and is adjacent to well DRMW-13. The C-8 concentration in well

DRMW-13A is less than in well DRMW-13; however, it does seem to indicate that Zone B's plume is also moving directly down the Dry Run valley.

As stated previously, Zone C is the deepest of the three groundwater zones. This zone is only penetrated by one groundwater monitoring well, DRMW-21B. Zone C is located approximately 120 feet below the Dry Run valley, and it has not been determined if it extends to the southeast and under the landfill. Zone C is at least 45 feet thick, and may be confined, as the groundwater surface in the well extended above the well's screen and the top of the sandstone-siltstone layer in the October 2002 sampling. Without additional wells penetrating Zone C, it is impossible at this time to determine the zone's extent or the groundwater flow direction and gradient. Well DRMW-21B contained no detectable concentrations of C-8 on the two occasions it was sampled, so it is presumed at this time that there is no C-8 in Zone C.

It is difficult to make any kind of conclusions regarding the surface water at the Dry Run Landfill because many of the sampling locations have been consistently dry during much of 2002. It is also difficult to make statements regarding the concentrations of C-8 found to date because these concentrations vary so much from sample location to sample location. The highest concentration of C-8 found at the surface sampling points is the Dry Run leachate location, where the concentrations of C-8 has ranged between 109 and 704 µg/l since December of 2001. The leachate is collected and hauled to the Washington Works Facility's treatment system, and does not discharge into Dry Run.

A further breakdown of the Dry Run Landfill sampling data is as follows:

Dry Run Landfill Surface Water: *(units are µg/l)*								
Sample Point	*Outlet 001*	*Outlet 003*	*Outlet 004*	*Property Boundary*	*Stream #1*	*Stream #2*	*Dry Run Leachate*	*Pond Under Drain*
Number of samples	15	3	2	12	11	11	12	8
Minimum C-8	17	6.77	0.7	0.88	0.54	4.6	27.4	29.3
Maximum C-8	88.5	25.3	158	39	1.63	87	704	99.7
Average C-8	58.57	17.39	79.35	11.3	1.07	40.29	205.59	50.98

Dry Run Landfill Groundwater Zone A: *(units are µg/l)*			
Sample Point	*DRMW-12*	*DRMW-13*	*DRMW-15*
Number of samples	13	12	10
Minimum C-8	<0.1	3.6	0.25
Maximum C-8	0.134	20.9	5.0
Average C-8	0.08	12.16	3.74

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Dry Run Landfill Groundwater Zone B: *(units are µg/l)*						
Sample Point	*DRMW-6*	*DRMW-6A*	*DRMW-12A*	*DRMW-12B*	*DRMW-13A*	*DRMW-14*
Number of samples	6	13	13	11	13	13
Minimum C-8	<0.1	0.19	<0.1	<0.1	0.07	<0.1
Maximum C-8	1.0	1.24	0.181	5.4	15	2.5
Average C-8	0.57	0.66	0.09	0.55	6.18	0.20

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Dry Run Landfill Groundwater Zone B: *(units are µg/l)*						
Sample Point	*DRMW-16B*	*DRMW-17B*	*DRMW-18B*	*DRMW-19B*	*DRMW-20B*	*DRMW-21A*
Number of samples	2	1	1	2	2	2
Minimum C-8	<0.1	0.155	<0.1	<0.1	<0.1	0.138
Maximum C-8	<0.1	0.155	<0.1	<0.1	<0.1	0.27
Average C-8	<0.1			<0.1	<0.1	0.204

Dry Run Landfill Groundwater Zone C: *(units are µg/l)*	
Sample Point	*DRMW-21B*
Number of samples	2
Minimum C-8	<0.1
Maximum C-8	<0.1
Average C-8	<0.1

LETART LANDFILL:

The Letart Landfill is located about 0.6 miles north of the small community of Letart in northern Mason County. It is 46 miles down the Ohio River from DuPont's Washington Works Facility, and is located at 38° 54' 15" North Latitude and 81° 55' 43" West Longitude. The site—like the Dry Run Landfill—is situated on the dissected Appalachian Plateau. Bedrock consists of the sandstones and shales of the Dunkard Group. It is sited in a valley that is directly west of the Ohio River, which is here flowing north. West of the landfill (and across the hill behind the landfill) is the north-flowing Brinker Run. The Letart Landfill was operated and closed under WV-NPDES Permit No. WV0076066, and was permanently closed by installing an engineered multi-layer

geosynthetic and soil cap in 2001. The permit requires quarterly groundwater monitoring, surface water monitoring, and cap maintenance.

Physically, the Letart Landfill is tear-shaped. It is approximately 1,400 feet long, and tapers in width from a maximum of 850 feet along its northern edge to a narrow point at the Ohio River. The elevation difference between the wider, higher northern boundary and the lowest elevation point near the Ohio River, is about 140 feet. The landfill itself is covered with grass. There are no highways, residents, or businesses adjacent to the landfill; however, U.S. Route 33 parallels Brinker Run, which is located about 700 feet to the west. This is a rural part of West Virginia, and there are no residents and businesses along this section of the highway.

Geologically, the bedrock beneath the landfill is comprised of individual layers of shale, silty clay, and sandstone and siltstone. There are, depending on how and where they are counted, between four and six aquifers at this site, which have been labeled by DuPont as Zone A, Zone B, Zone C, Zone D, Zone E, and Zone F. Zone A is the shallowest of these aquifers, and is monitored by three groundwater monitoring wells. Zone B contains no wells, and Zone C contains only one well. Zone D-E contains five groundwater monitoring wells, and Zone F, the deepest and dominant aquifer at this site, has nine wells screened through it.

Groundwater Zone A is exposed near the surface, and varies between 25 and 60 feet thick. It is continuous in nature, but apparently contains interbedded discontinuous shale, sandstone, and siltstone lens.

There are only three wells screened in Zone A. These wells are all located relatively close together and more-or-less in a straight line along the northwestern edge of the landfill. Given these limitations, the October 2002 groundwater sampling gave the appearance of a north groundwater flow and a plume that centered on well LMW-1, the central-most of the three wells.

Of the three Zone A wells, LMW-1 has the highest concentrations. These concentrations have varied since April 1996 between 1,700 and 30,500 µg/l. Well LMW-8 has the next-highest concentrations, and these concentrations have varied between 280 and 4,020 µg/l. Well LMW-7 has displayed the least concentrations of C-8 in these wells since October 1999 between 158 and 567 µg/l.

There are no wells screened through Zone B. However, judging from the cross-section produced when the deeper wells were drilled, this zone reaches its maximum thickness of more than 70 feet at the northern-most tip of the landfill, where it is combined with Zone C. Zone B pinches out (disappears) completely as one moves down the landfill toward the river.

Zone C appears to be continuous across the site. It is approximately 15 to 25 feet thick under the main and southern portions of the landfill, and combines with Zone B in the northern part of the site. Only one well is screened through Zone C, so no assessment of a plume or groundwater flow and direction can be made. This well,

LMW-3, is located near the very toe of the landfill and in close proximity to the Ohio River. This well had a concentration of 2,270 µg/l C-8 in May 2002.

Zone D-E is the most complex of the Letart water-bearing zones. These zones appear to be combined in the southern, central, and northern portions of the site. They are separated by a shale layer in the western and possibly the central portion of the landfill. It is also possible that Zone D may be completely missing in the northern and northeastern portions of the site. The thickness of this zone can range between 10 and 40 feet. Zone D-E, as mapped by DuPont in October 2002, has a gradient of 0.026 vertical feet per horizontal foot with a groundwater flow direction to the south-southwest.

There are five groundwater monitoring wells screened through Zone D-E. Most of these wells are located near the southern toe of the landfill. Of these five wells, two were only recently installed, and long-term data exists for three of the wells. LMW-4 has consistently contained the highest concentrations of C-8. These concentrations have ranged from 172 to 2,840 µg/l.

All five of the Zone D-E groundwater monitoring wells sampled in October of 2002 indicate high C-8 concentrations under the main part of the landfill, with a plume flowing due south and through LMW-4. Two wells, located just east of LMW-4 contained much lower concentrations of C-8.

As previously stated, groundwater Zone F is believed to be the dominate aquifer at the Letart Landfill. This zone is the deepest of the six aquifers. It is continuous across the site ranging from 30 to 70 feet thick. The groundwater within the zone flows to the south-southeast. This zone has a gradient of between 0.030 to 0.057 vertical feet per horizontal foot.

There are nine groundwater monitoring wells screened through Zone F positioned all around the landfill. Six of these were sampled prior to October 2002, and seven were sampled in October of 2002. These wells project a possible C-8 plume moving south down the center of the landfill. The lowest concentrations are to the west of the landfill, where there is one concentration of 105 µg/l in well LMW-14B. The highest C-8 concentration is at the very toe of the landfill at well LMW-5B, which has consistently contained high concentrations since it was installed more than a decade ago. Since July of 1999, these concentrations have ranged between 592 and 2,280 µg/l.

Zone F well LMW-2A contains high concentrations of C-8 that have varied between 242 and 913 µg/l since September of 1994. In addition, this well is located on the extreme northern edge of the landfill, away from the anticipated plume direction. Well LMW-12, drilled just to the west of LMW-2A, was dry during the October 2002 sampling event. These two wells should be monitored closely to determine groundwater flow direction and if there is a plume moving off the site to the north. It should also be noted that there is a private water source ((b) (6)(b) (6) north of the Letart Landfill where a small concentration of C-8 was found.

It should be noted that, due to the installation of the synthetic cap, stormwater contribution to the groundwater flow has been lessened under the landfill. It is probable that the contribution of C-8 to this flow has remained stable. Less groundwater volume combined with a steady contribution of C-8 will equal a higher concentration of C-8 in the groundwater. This scenario appears to have occurred at the Letart Landfill. The site should be monitored closely to ascertain trends in C-8 concentrations.

The surface water at the Letart Landfill has been sampled for C-8 at six locations. The data for some of these points is very intermittent. While most of these concentrations are very low, C-8 has been found at the two Brinker Run sampling locations. The two highest concentrations were found at the southern toe of the landfill, at Outlet 002 (the Leachate Basin) and the Cap Runoff location, both of which indicate increasing concentrations of C-8. Outlet 002 and the Cap Runoff have had concentrations as high as 3,240 and 415.6 µg/l, respectively.

A detailed breakdown of the surface and groundwater data is as follows:

Letart Landfill Surface Water: *(units are µg/l)*						
Sample Point	*Outlet 002*	*Outlet 003*	*Stormwater Run Off*	*Route 33 Stream*	*Brinker Run*	*Cap Runoff*
Number of samples	18	6	1	13	2	6
Minimum C-8	4.52	0.06	50.9	0.57	0.06	65.1
Maximum C-8	3240	0.239	50.9	3.92	0.247	415
Average C-8	899.22	0.21		1.96	0.154	225.18

Letart Landfill Zone A Groundwater: *(units are µg/l)*			
Sample Point	*LMW-1*	*LMW-7*	*LMW-8*
Number of samples	21	20	20
Minimum C-8	60	0.1	280
Maximum C-8	30,500	567	4020
Average C-8	14,896.57	233.57	2499

Letart Landfill C Zone Groundwater: *(units are µg/l)*	
Sample Point	*DRMW-3*
Number of samples	8
Minimum C-8	<0.1
Maximum C-8	2270

Average C-8	1320

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Letart Landfill D-E Zones Groundwater: *(units are µg/l)*					
Sample Point	*LMW-3A*	*LMW-4*	*LMW-5A*	*LMW-13A*	*LMW-14A*
Number of samples	10	12	8	2	2
Minimum C-8	60.3	172	0.8	144	498
Maximum C-8	380	3060	112	510	974
Average C-8	170.39	1577.83	71.43	327	736

Letart Landfill Zone F Groundwater: *(units are µg/l)*									
Sample Point	*LMW-2A*	*MW-5B*	*LMW-6*	*LMW-9*	*LMW-10*	*LMW-11*	*LMW-12*	*LMW-13B*	*LMW-14B*
Number of samples	23	22	12	9	5	8	0	2	2
Minimum C-8	50	340	9.4	0.2	0.126	0.058		0.09	70.4
Maximum C-8	990	2280	30	0.91	0.298	0.159		0.149	105
Average C-8	496.8	1161.9	17.49	0.65	0.165	0.110		0.1223	87.7

LOCAL LANDFILL:

The Local Landfill is located immediately south of the Washington Works Facility in northwestern central Wood County. It consists of three separate closed cells, and is located at 39° 15' 54" North Latitude and 81° 39' 16" West Longitude. It is situated on the dissected Appalachian Plateau, consisting of Dunkard Group sandstones and shales. The three landfill cells were operated from 1964 into the 1980s, and were closed under WV-NPDES Permit No. WV0076538. They are now covered with approximately two feet of low permeability soil and vegetative cover. The site is in a somewhat rural area; however, there are a number of residential homes south of the landfill. State Highway 892 is just north of the landfill and located between the landfill and DuPont's Washington Works Facility.

Physically, the three Local Landfill cells are 60 by 140, 70 by 110, 40 by 60 feet in size; however, the landfill cells are irregular in shape and the cells are actually smaller than these dimensions indicate. These cells are sited along the tops and sides of three hills, which are located just south of the flat Ohio River flood plain.

Geologically, the bedrock beneath the landfill is comprised of individual layers of

shale, silty clay, and sandstone and siltstone. There are four principal aquifers, all of which are continuous under the overall site, and are comprised of sandstone and siltstone. DuPont has named these (in their October 2002 groundwater monitoring report), from shallowest to deepest, Zone A, Zone B, Zone C, and Zone D. Zone A is believed to be the dominant aquifer.

Zone A is usually between 10 to 20 feet thick, and varying in depth between 60 to 110 feet. This zone is continuous across the site, and has been eroded by an unnamed stream that flows out of the landfill area to the west, and then flows to the northwest. Groundwater flow in Zone A is to the north-northwest with a gradient of 0.008 vertical feet per horizontal foot. There are four groundwater monitoring wells screened in Zone A. Two of these have consistently contained C-8 concentrations that are below 1 µg/l. A third well, LLMW-6, has contained C-8 concentrations below 10 µg/l. The fourth well, LLMW-4, contains C-8 concentrations up to 79 µg/l. This supports the theory that the Zone A C-8 plume is moving north toward LLMW-4.

Zone B is generally 5 to 10 feet thick, and between 90 to 130 feet deep. It is incised by the unnamed surface stream, and grades out to the east. There is only one well screened in this zone, and has only been sampled twice. It contained a C-8 concentration of 0.0658 µg/l in October 2002 and a No Detect concentration in March of 2003. With only one well, no plume information or groundwater flow and gradient data can be generated on this groundwater zone.

Zone C is 10 to 20 feet thick, and 90 to 130 feet deep. It is continuous across the entire site. Due to Zone C's greater depth, it has not been incised by the surface stream. Groundwater flow is to the northwest, and the gradient is 0.0153 vertical feet per horizontal foot. Three wells are screened in this zone. Each well has been sampled twice, and the C-8 concentrations ranged from 0.317 to 6.61 µg/l.

Zone D is more than 12 feet thick, and is 135 to 170 feet deep. Only one well has been screened in this zone, and has only been sampled twice, with No Detect concentrations on both occasions. With only one well, no plume information or groundwater flow and gradient data can be generated for Zone D.

Six sampling locations are used to monitor the surface water at the Local Landfill. All of these locations have displayed concentrations of C-8 with the highest concentrations occurring at Outlet 101 and Outlet LM1. These concentrations ranged from 38 µg/l in June 2002 to 72 µg/l in January 2003, and dropped to 45.4 µg/l in March 2003. Outlet LM1's concentrations are higher: They were 120 and 81.7 µg/l on the two occasions this location was sampled.

The Local Landfill data can be further broken down as follows:

Local Landfill Surface Water: *(units are µg/l)*						
Sample Point	*Outfall 004*	*New 004*	*Outfall 005*	*New 005*	*Outlet 101*	*Outlet LM1*
Number of samples	15	6	15	3	19	2
Minimum C-8	1.51	9.29	6.8	9.51	12	81.7
Maximum C-8	13	14.6	51.4	34.3	115	120
Average C-8	10.1	12.69	35.19	19.94	57.1	100.85

Local Landfill Zone A Groundwater: *(units are µg/l)*				
Sample Point	*LLMW-4*	*LLMW-6*	*LLMW-9*	*LLMW-10*
Number of samples	13	13	13	10
Minimum C-8	1.4	1.32	<0.1	0.15
Maximum C-8	79.6	19.9	0.14	1.12
Average C-8	42.63	11.06	0.02	0.41

Local Landfill Zone B Groundwater: *(units are µg/l)*	
Sample Point	*LLMW-12B*
Number of samples	2
Minimum C-8	<0.1
Maximum C-8	0.0658
Average C-8	0.0329

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Local Landfill Zone C Groundwater: *(units are µg/l)*			
Sample Point	*LLMW-11A*	*LLMW-13B*	*LLMW-14B*
Number of samples	2	2	2
Minimum C-8	2.05	6.38	0.317
Maximum C-8	2.22	6.61	0.488
Average C-8	2.135	6.495	0.4025

Local Landfill Zone D Groundwater: *(units are µg/l)*	
Sample Point	*LLMW-11B*
Number of samples	2
Minimum C-8	<0.1
Maximum C-8	<0.1
Average C-8	<0.1

WASHINGTON WORKS FACILITY:

The DuPont Washington Works Facility is located just north of the small community of Washington and about seven miles west and downstream of Parkersburg. The facility is located at 39° 16' 13" North Latitude and 81° 40' 34" West Longitude, and is sited on the Ohio River flood plain. The flood plain here is comprised of Pleistocene glacial outwash and Holocene river sediments (alluvium) overlying the bedrock of the Dunkard Group. These sediments are comprised of sand and gravel, silt and clay, colluvium, and fill. The site is in a somewhat rural area. State Route 892 is located just south of the plant property. The Ohio River is located immediately to the north of the property.

There are more than 100 groundwater monitoring and production wells at the Washington Works Facility. Of these wells, the following 19 wells were chosen by the GIST to be sampled under the Consent Order:

AE11-MW01	D08-MW01	N04-MW01	Q04-MW02	AJ06-MW02
AM07-PW01	E13-MW01	N13-MW01	R04-MW02	N04-MW03
A008-PW01	K16-PW01	P04-MW2	V05-PW01	Y14-MW02
AX13-PW01	L04-PW01	P08-MW01	Y14-MW01	

Of these wells, five have consistently been less than 1 µg/l, and another seven have been less than 20 µg/l. Three of the remaining wells have had C-8 concentrations between 20 and 60 µg/l; however, one of these wells (P08-MW01)—when last sampled—contained 120 µg/l. A fourth well, N04-MW01, has only been sampled once, but this concentration was 689 µg/l.

The remaining three wells all contain high concentrations of C-8. These are wells P04-MW-2, Q04-MW-02, and R04-MW02, with reported concentrations as high has 46,600, 7,720, and 322,000 µg/l of C-8, respectively.

At present, six outlets are used to monitor the discharges at the Washington

Works Facility. With a few exceptions (one of which was Outfall 005 in November 2001 with a concentration of 915 µg/l), all of these outlets have had consistently discharged relatively low concentrations of C-8, ranging from ND to 54.9 µg/l.

A further breakdown of the Washington Works Facility discharge water and groundwater data is as follows:

Washington Works Facility Surface Water: *(units are µg/l)*						
Sample Point	*Outlet 001*	*Outfall 002*	*Outlet 003*	*Outfall 005*	*Outlet 007*	*Outlet 105*
Number of samples	16	25	16	26	16	16
Minimum C-8	2.15	0.118	0.175	1.43	<0.1	3.69
Maximum C-8	51.4	8.54	7.13	915	8.56	54.9
Average C-8	14.39	3.21	1.544	81.15	1.42	14.43

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Washington Works Facility Groundwater: *(units are µg/l)*						
Sample Point	*AE11-MW01*	*AM07-PW01*	*AC08-PW01*	*AX13-PW01*	*D08-WM01*	*E13-MW01*
Number of samples	10	16	14	7	8	11
Minimum C-8	0.41	<0.1	0.167	0.721	0.117	0.59
Maximum C-8	2.82	1.9	1.0	1.42	3.72	3.43
Average C-8	1.41	0.374	0.46	1.03	0.882	2.127

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Washington Works Facility Groundwater: *(units are µg/l)*							
Sample Point	*K16-PW01*	*L04-PW01*	*N04-MW01*	*N13-MW01*	*P04-MW2*	*P08-MW01*	*Q04-MW02*
Number of samples	11	13	1	3	11	4	10
Minimum C-8	0.46	0.20	689	<0.1	8300	20.7	32.2
Maximum C-8	17.2	40.9	689	57.8	46600	120	7720
Average C-8	11.3	15.01		29.13	28545	55.02	1780

Note: For the purposes of averaging these values, a No Detect concentration of "<0.1" was calculated as zero.

Washington Works Facility Groundwater: *(units are µg/l)*						
Sample Point	*R04-MW02*	*V05-PW01*	*Y14-MW01*	*AJ06-MW02*	*N04-MW03*	*Y14-MW02*
Number of samples	11	13	10	2	2	2
Minimum C-8	1300	0.66	4.95	0.099	21.2	<0.1
Maximum C-8	322000	51.2	18.4	0.133	244	<0.1
Average C-8	69729	26.2	13.76	0.116	132.6	<0.1

RECOMMENDATIONS:

The first priority at each of the four sites is to continue the surface and groundwater monitoring programs. Sampling of the groundwater should continue to be quarterly, while the outfall sampling can be either monthly, quarterly, or semi-annually, as required by each site's individual NPDES permit.

The continuing source of C-8 at the Washington Works Facility is believed to be originating from a previously reclaimed digestion pond and from the old River Bank Landfill. Currently, the facility is under a RCRA Facility Investigation, which is addressing these C-8 sources. It is the recommendation of the GIST that any action relative to the investigation or remediation of the C-8 sources be deferred to the WSEPA-WVDEP RCRA Corrective Action Program (CAP).

GROUNDWATER MODELING

Groundwater modeling of the Washington Works Facility's main location was completed independently by DuPont's URS Diamond contractor and by the United States Geological Survey (USGS). URS Diamond's modeling was completed using Groundwater Vistas software. The USGS model was completed using Visual Modflow software. Both models were based on similar calibration data and boundary conditions.

The USGS groundwater model did not address groundwater seepage from the adjacent bedrock aquifers, whereas the URS Diamond groundwater model did address this seepage. Preliminary analysis of both models show close agreement in groundwater flow directions, calibrated heads, and rate and volume of groundwater flow. The model data that follows is primarily from the URS Diamond groundwater model. The USGS groundwater model will be published as part of a larger modeling effort in corporation with the WVDHHR-BPH, Office of Environmental Health Services (OEHS).

The URS Diamond model boundary was the alluvium, and into bedrock. The URS Diamond model domain was 5.0 to 7.9 miles, consisting of 153 rows, 235 columns, and 3 cells deep. Fifty-one discharge wells were included in the simulation. In the beginning stages of building the models, a major gap in the data occurred due to lack of data concerning river bottom geometry. The data gap was eliminated by a great abundance of new data obtained from recent surveys compiled by the Army Corps of Engineers for construction projects at the eastern end of the model domain.

GEOLOGY:

The alluvium was found to be between 60 to 80 feet deep on terraces and 10 to 15 feet deep in the center of the river valley. Alluvial aquifers in the model domains were mostly unconfined, with some locally confined by Holocene overbank deposits. These alluvial aquifers consist of coarse sands and gravel underlain by predominately horizontally bedded sandstones of the Pennsylvanian Dunkard Group. The Ohio River creates a groundwater divide in the Pleistocene alluvium under the river. This groundwater divide does not appear to exist in the bedrock aquifer.

Typically, the permeability of the alluvium was 100 to 300 feet per day. Bedrock aquifers were primarily confined, and consisted of Dunkard sandstones with some minor limestone. Permeability of the bedrock aquifers ranged from 0.5 to 5 feet per day. Hydraulic conductivity used in the models were 330 feet per day for coarse alluvium, 30 feet per day for reworked alluvium, and one foot per day for fine alluvium. Hydraulic conductivity for bedrock aquifers was 0.1 feet per day. Alluvial aquifers on Blennerhassett Island had a hydraulic conductivity of 200 feet per day. The normal pool level of 582 feet above sea level was used for the hydraulic head of the Ohio River.

MODEL CALIBRATION:

A total of 50 industrial and public water supply wells are located in the model domain, 44 of which were actively pumping at the time when synoptic groundwater elevations were being measured for model calibration. The well locations to the model domain are:

- DuPont Washington Works Facility (WV): 13 wells
- Blennerhassett Island State Park (WV): 12 wells
- GE Facility (WV): 14 wells
- Lubeck (WV) PSD: 6 wells
- City of Belpre (OH): 1 well (Note: Belpre has five pumping wells; their total flow was assigned to one well for the model.)
- Little Hocking (OH) Water Well Field (wells PW-1, PW-2, and PW-3 were included in the model. Although well PW-5 was included, no pumping was simulated) 4 wells

The mass balance of the groundwater flow model had a total error of less than one percent, indicating very little error in simulating real world conditions.

Recharge was estimated to be an average of approximately 8 to 10 inches per year, according to the USGS model. URS Diamond's model was calibrated at eight inches per year and, as the modeler for the USGS agreed, seemed to satisfy conductivity calibrations better. Differences in the two figures arose from different interpretations of possible areas of incised valley bottom fills under the Ohio River. These areas may have slightly different hydraulic conductive properties from the adjacent sediments.

Sensitivity analysis was run on three parameters: hydraulic conductivity, recharge, and river boundary conductance. This sensitivity analysis indicated that most of the uncertainty associated with the model was in the value assigned to the re-worked Pleistocene alluvium under the Ohio River.

CONCLUSIONS:

The calibration of both models was tested and highly refined over the course of the modeling effort. Both models were only slightly different. All parties placed high confidence in the somewhat more sophisticated URS Diamond model. The USGS further refined their model by incorporating some of the data presented in the URS Diamond model.

The Ohio River creates a groundwater divide in the Pleistocene alluvium under the river. The principal conclusion, supported by both models, was that the groundwater

divide under the river, along with the pumping rates from the DuPont and neighboring GE Facility wells that draw down a cone of depression, precludes C-8 impacted groundwater from the Washington Works Facility from being drawn into either Lubeck PSD municipal well field in West Virginia, or the Little Hocking Water Association well field in Ohio. Some limited groundwater may migrate off-site in the northwest corner of the DuPont facility in response to GE pumping wells #3 and #4. Sources of C-8 in the Lubeck PSD and the Little Hocking Water Association wells, are most likely coming from the Ohio River and dispersion by air.

RECOMMENDATION:

It is the recommendation of this report that the URS Diamond model be accepted as representing real-world conditions in determining groundwater flow and contaminant transport.

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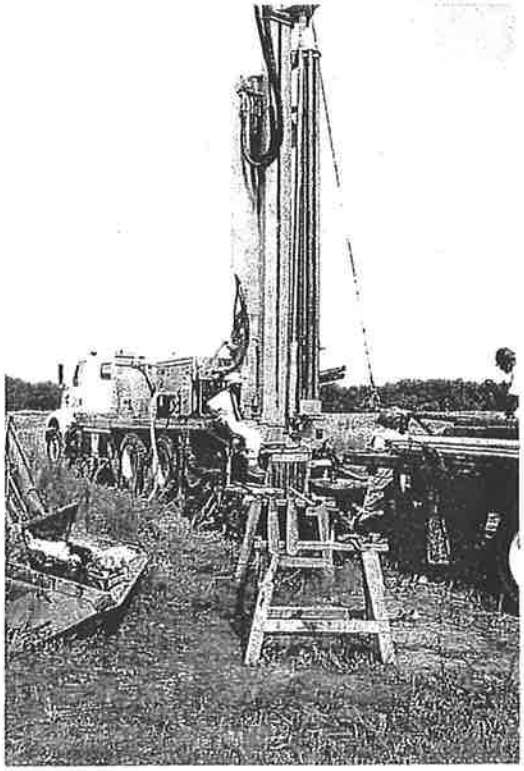

An air rotary drilling rig installing a new groundwater monitoring well at the Letart Landfill.

APPENDIX A:

Site Maps
Topographic Maps
Plan Views
Groundwater-Top Maps
Site Cross-Sections

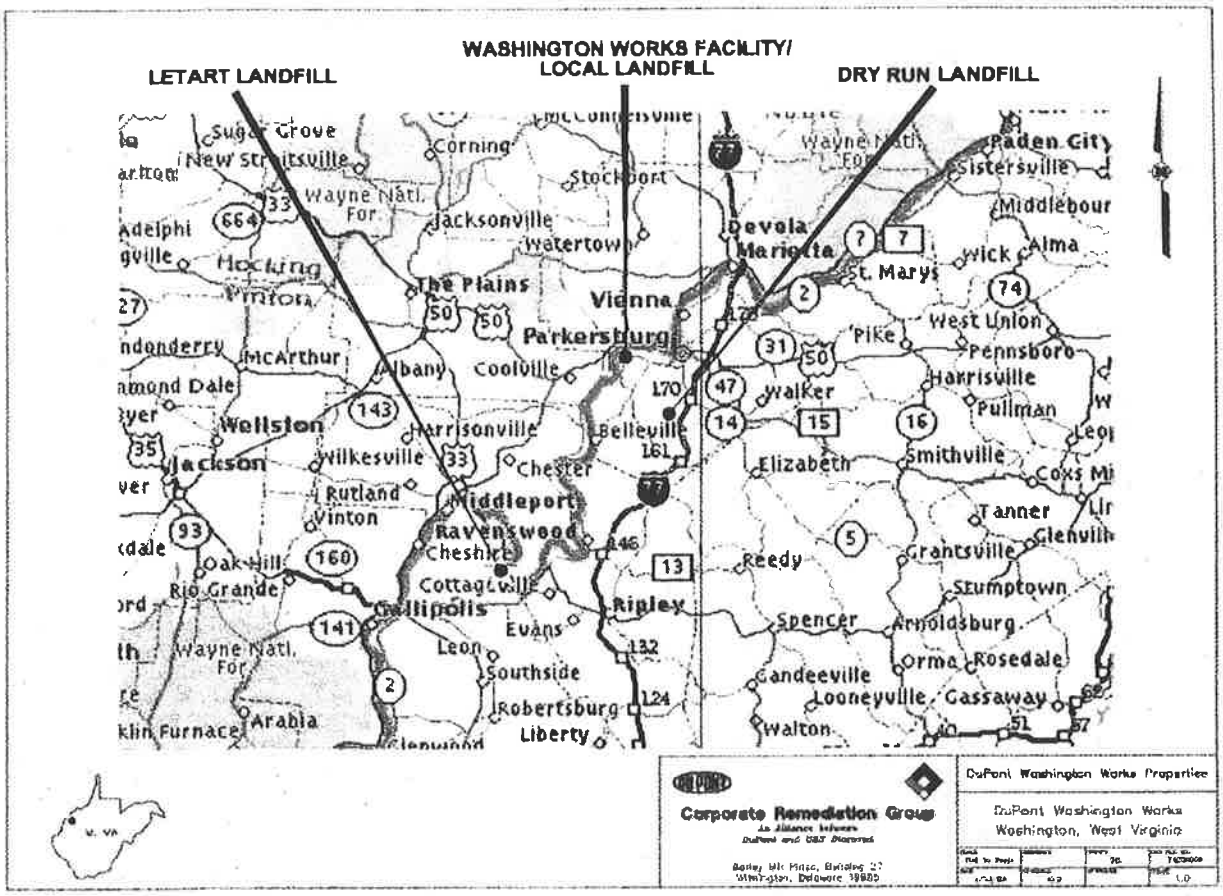

Figure 1.0: Index map for the four Dupont sites.

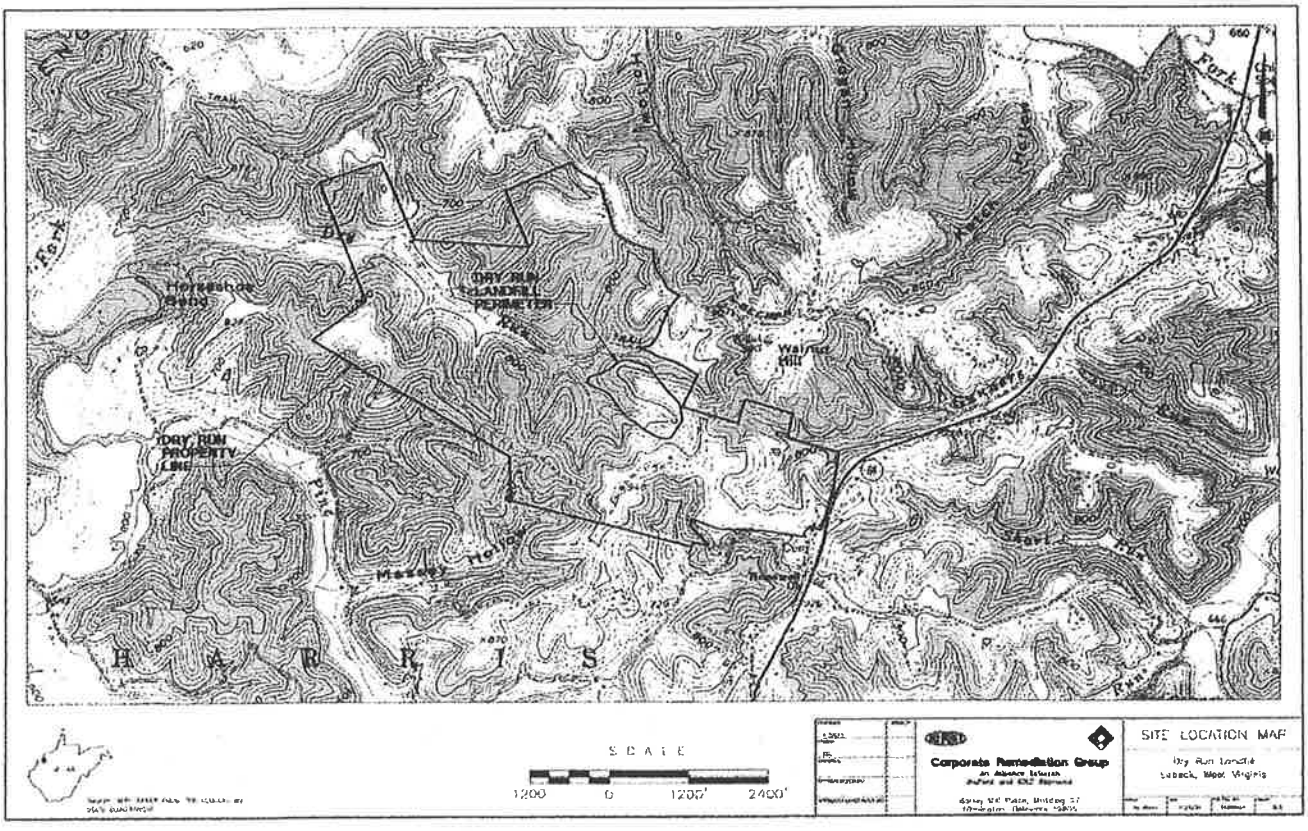

Figure 2.0: Location map for the Dry Run Landfill.

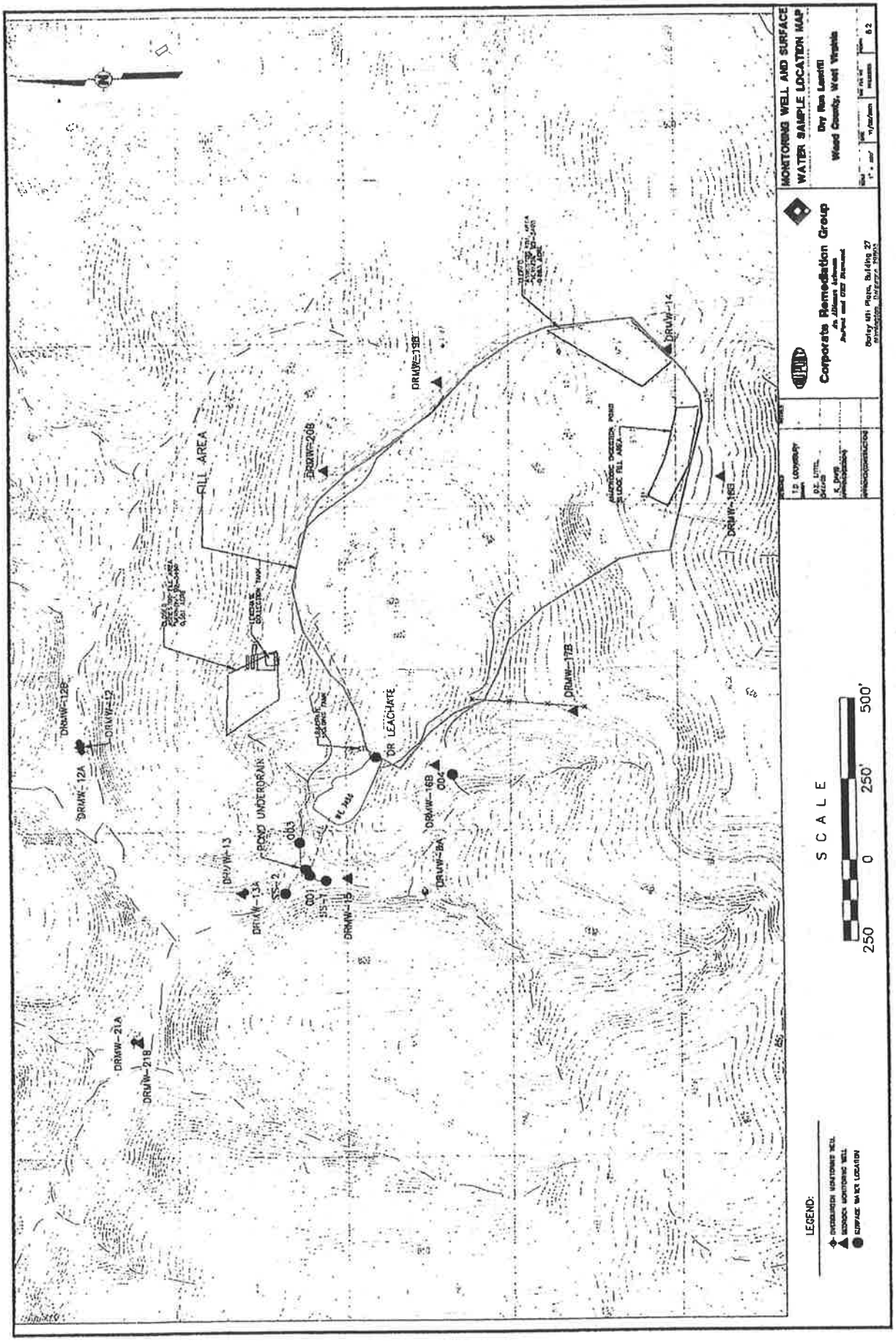

Figure 2.1: Dry Run Landifll with sampling points.

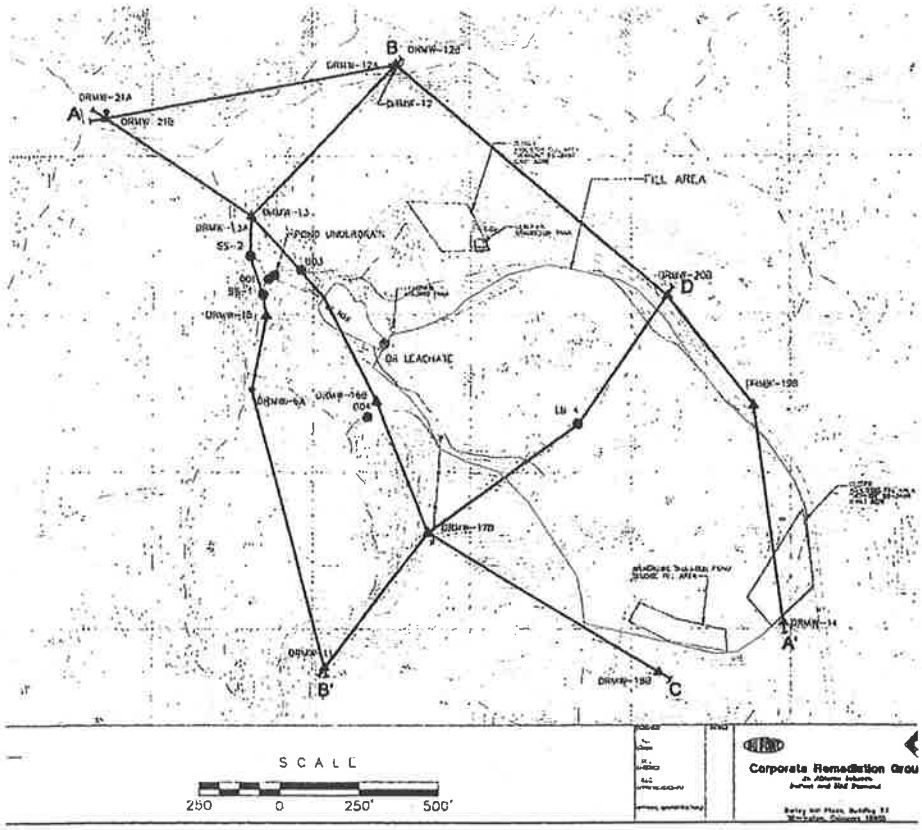

Figure 2.2: The Dry Run Landfill Geological Cross-Section Lines.

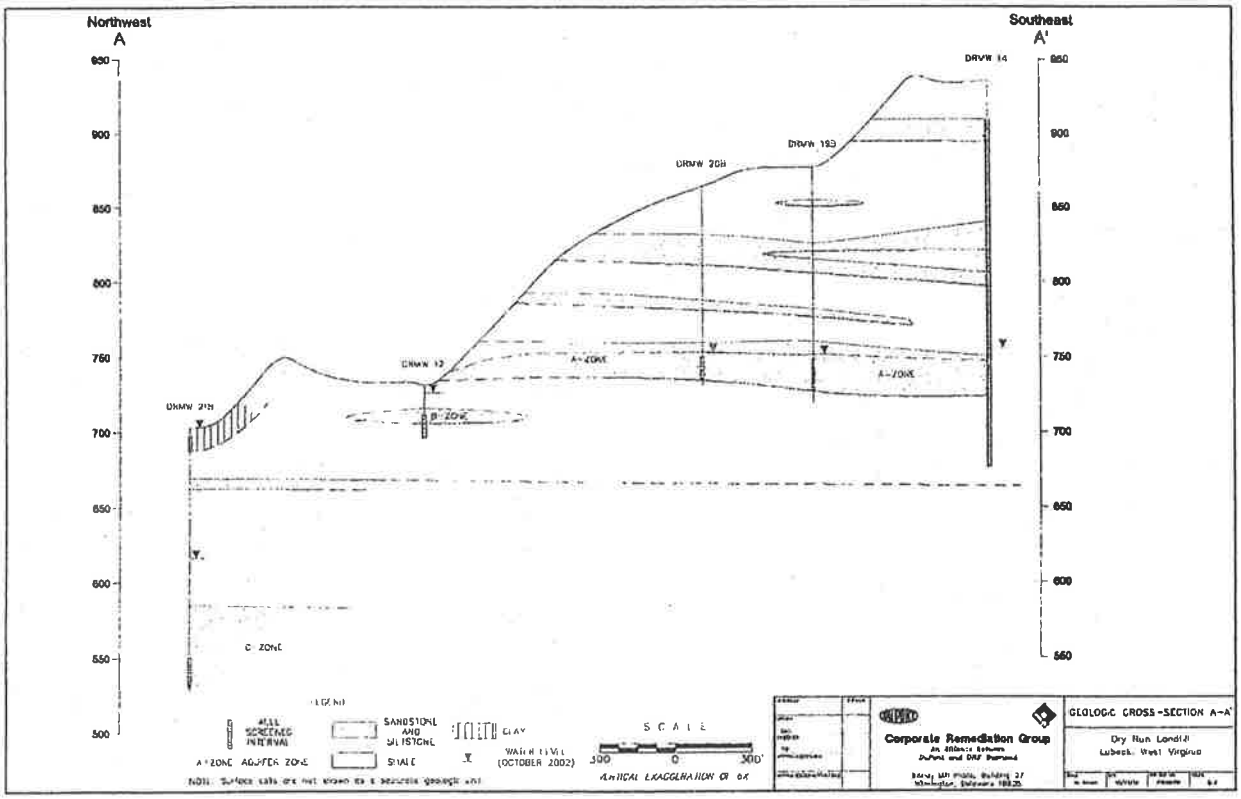

Figure 2.3: Dry Run Geological Cross-Section A-A'

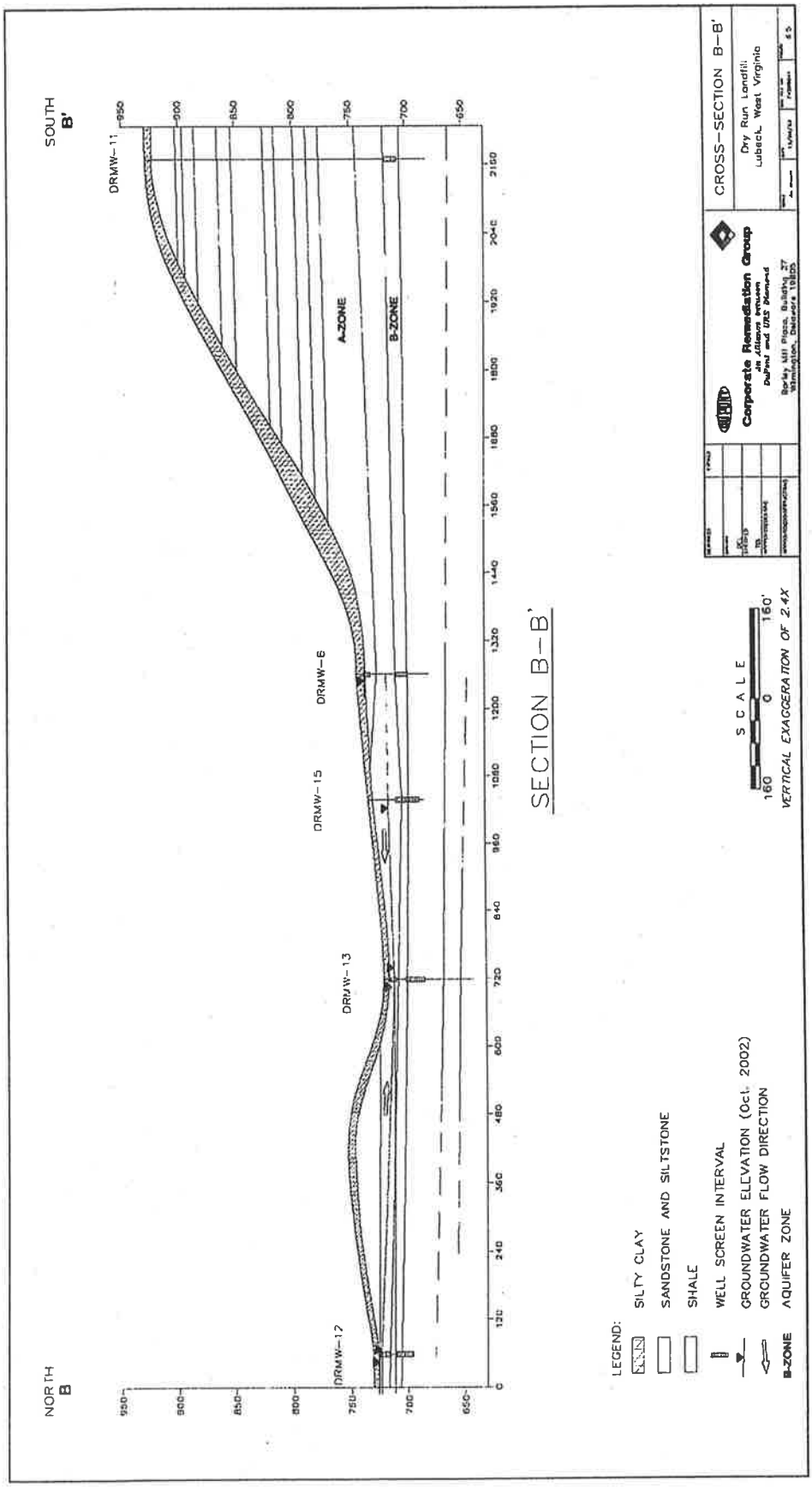

Figure 2.4: Dry Run Geological Cross-Section B-B'.

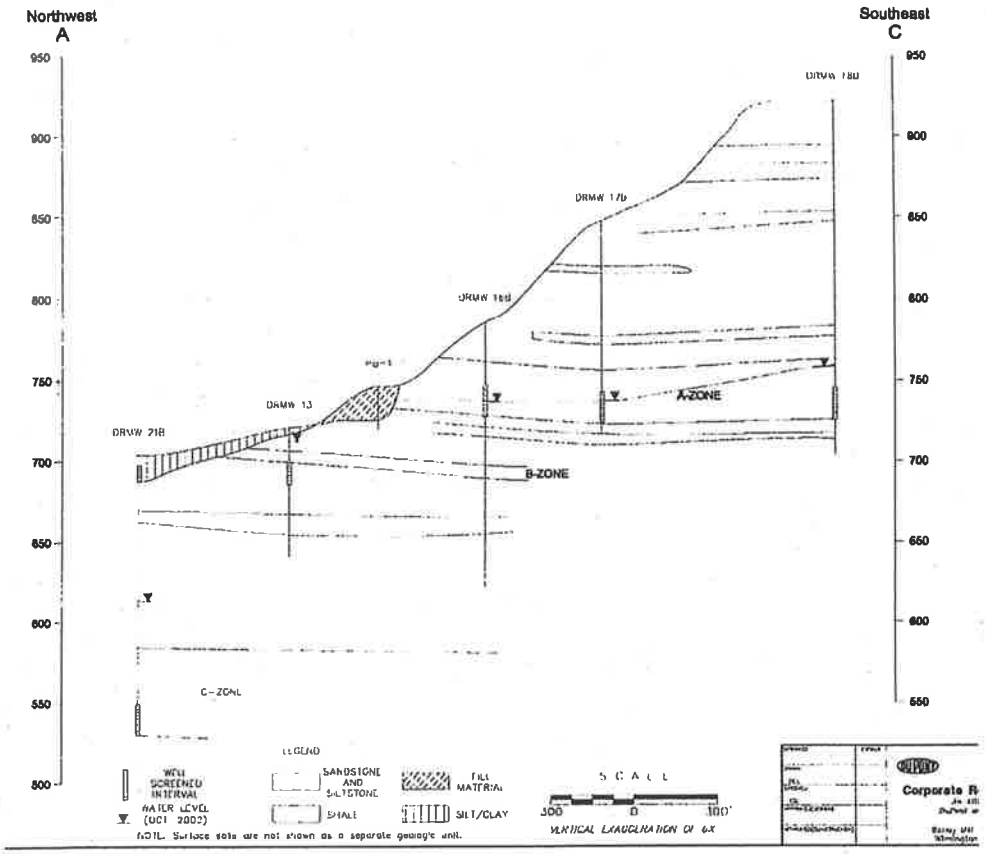

Figure 2.5: Dry Run Geological Cross-Section A-C.

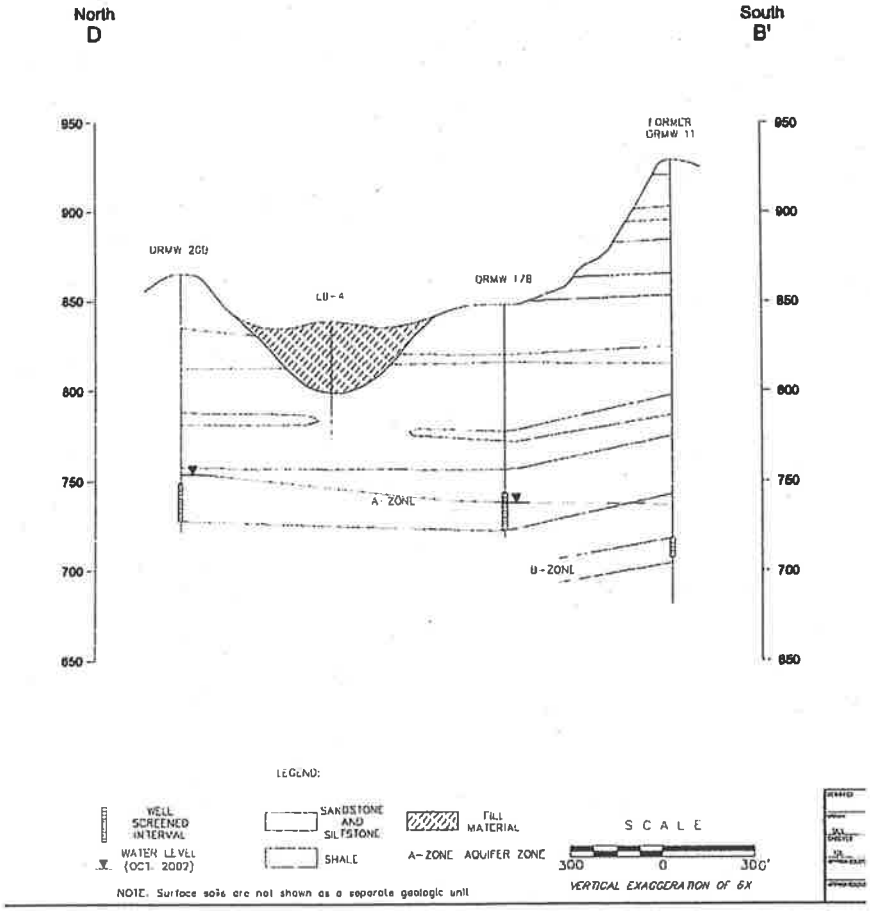

Figure 2.6: Dry Run Geological Cross-Section D-B'

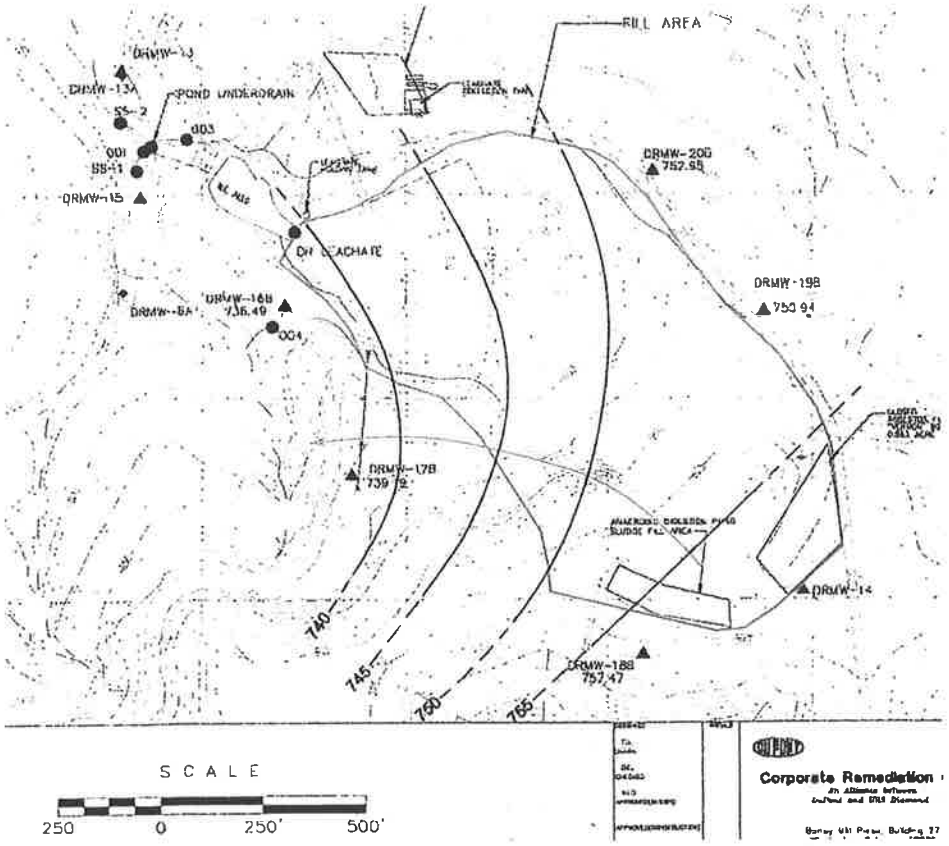

Figure 2.7: Dry Run Zone A Top-of-Groundwater Map.

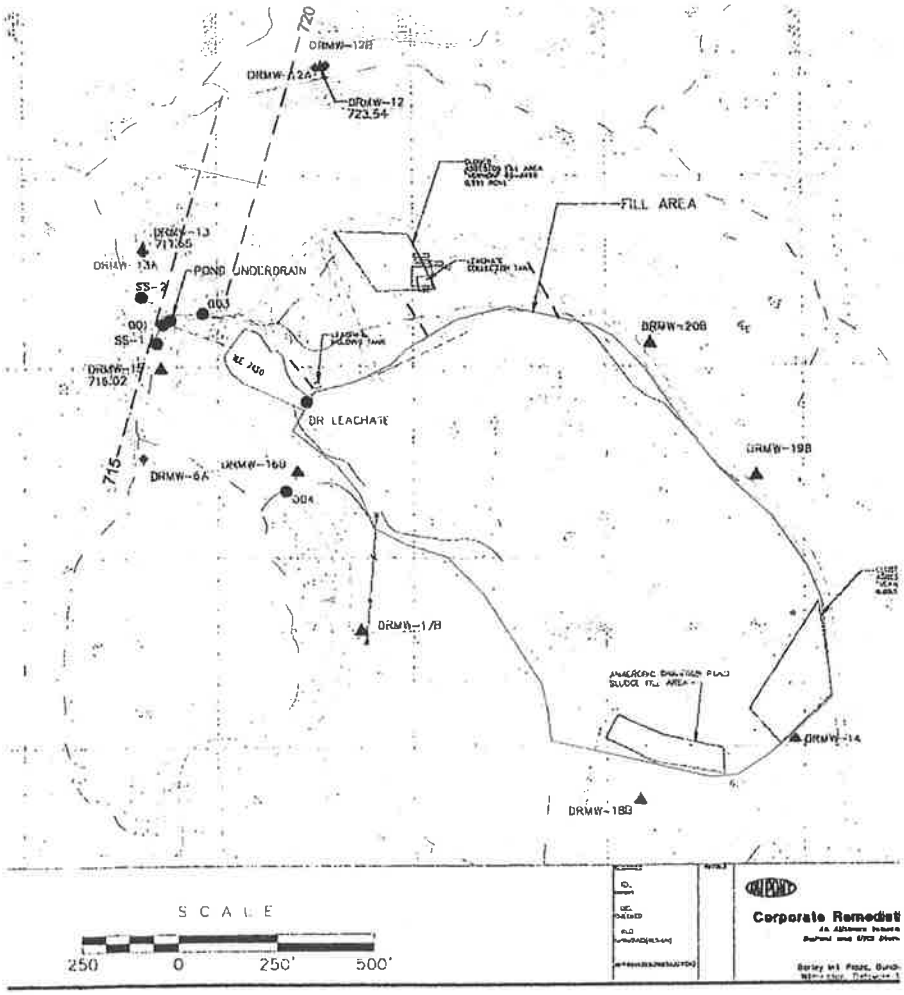

Figure 2.8: Dry Run Zone B Top-of-Groundwater Map.

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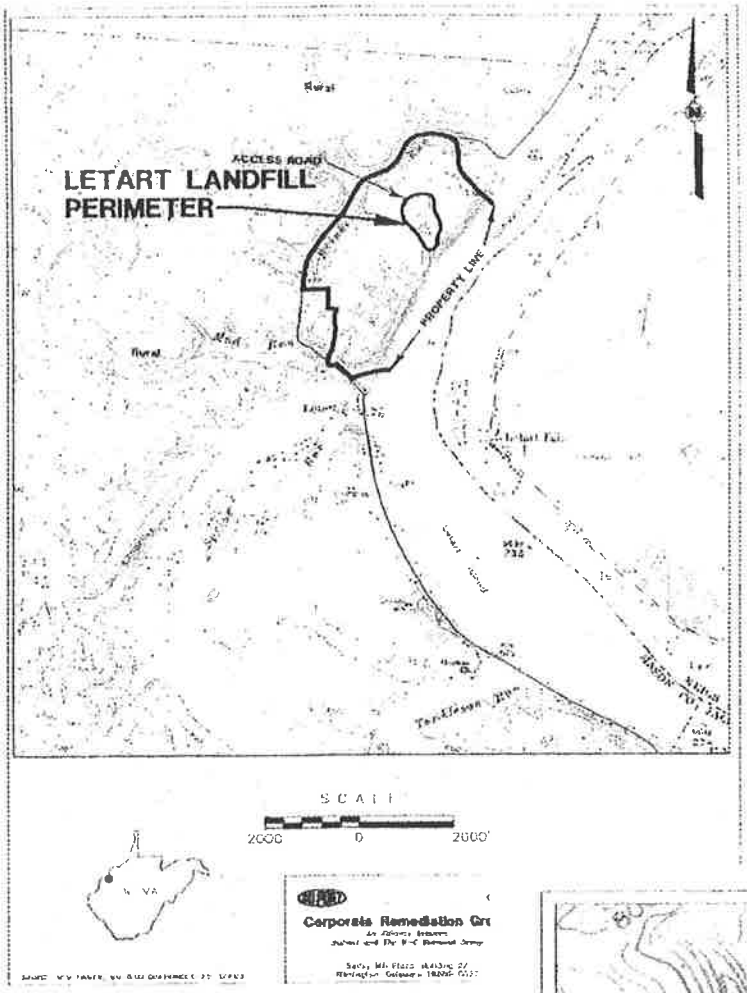

Figure 3.0: Letart Landfill Location Map.

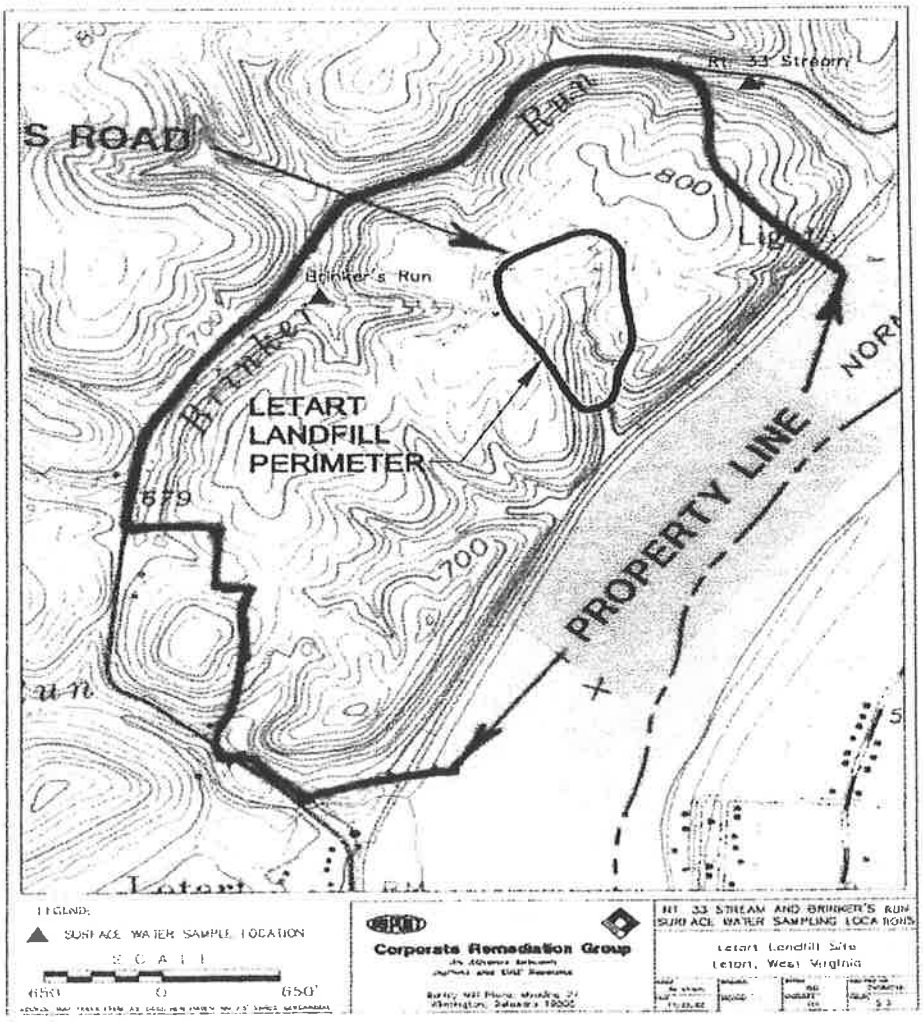

Figure 3.1: Letart Landfill Location Map Close-Up.

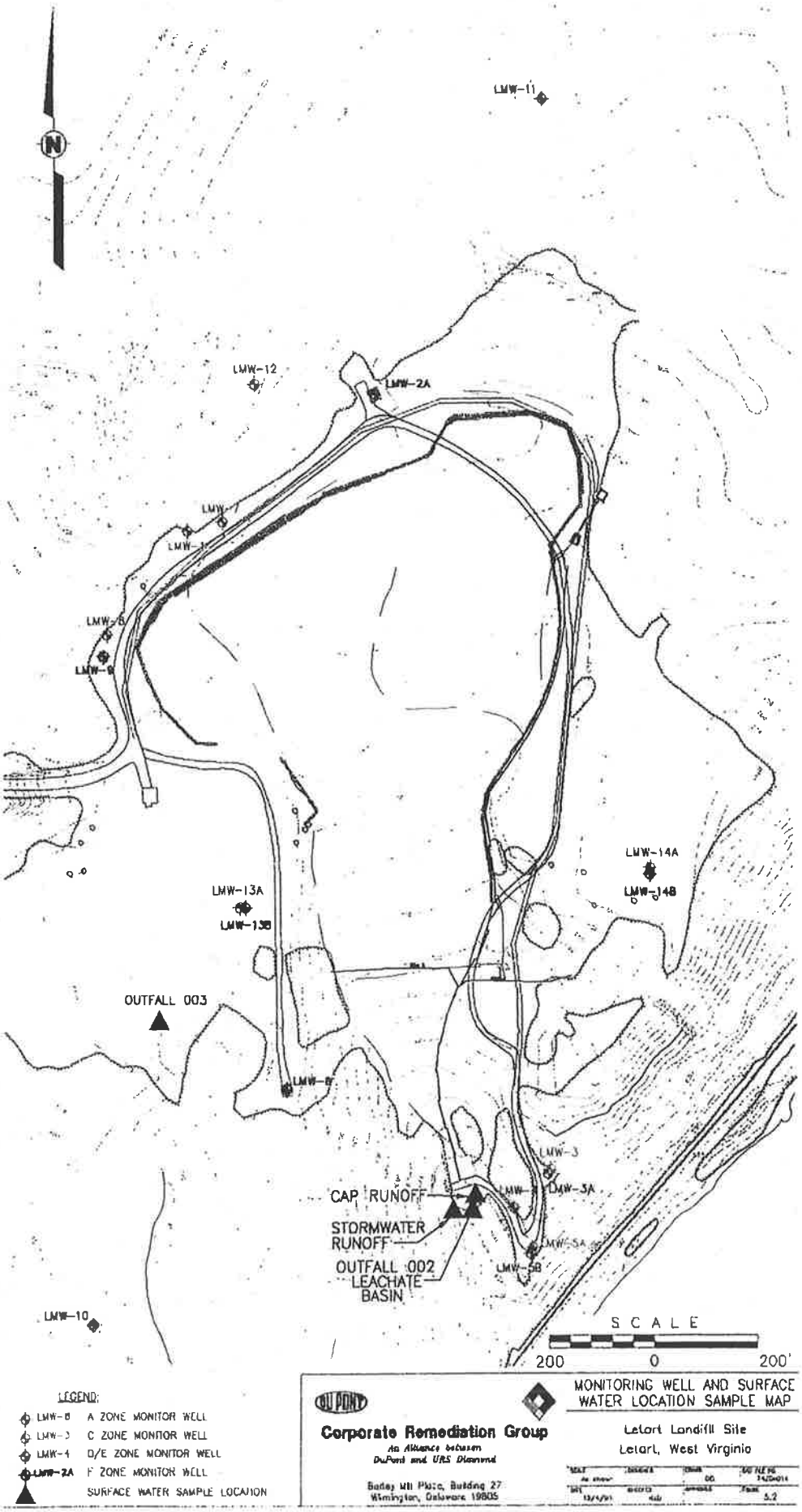

Figure 3.2: Letart Landfill and Sampling Points.

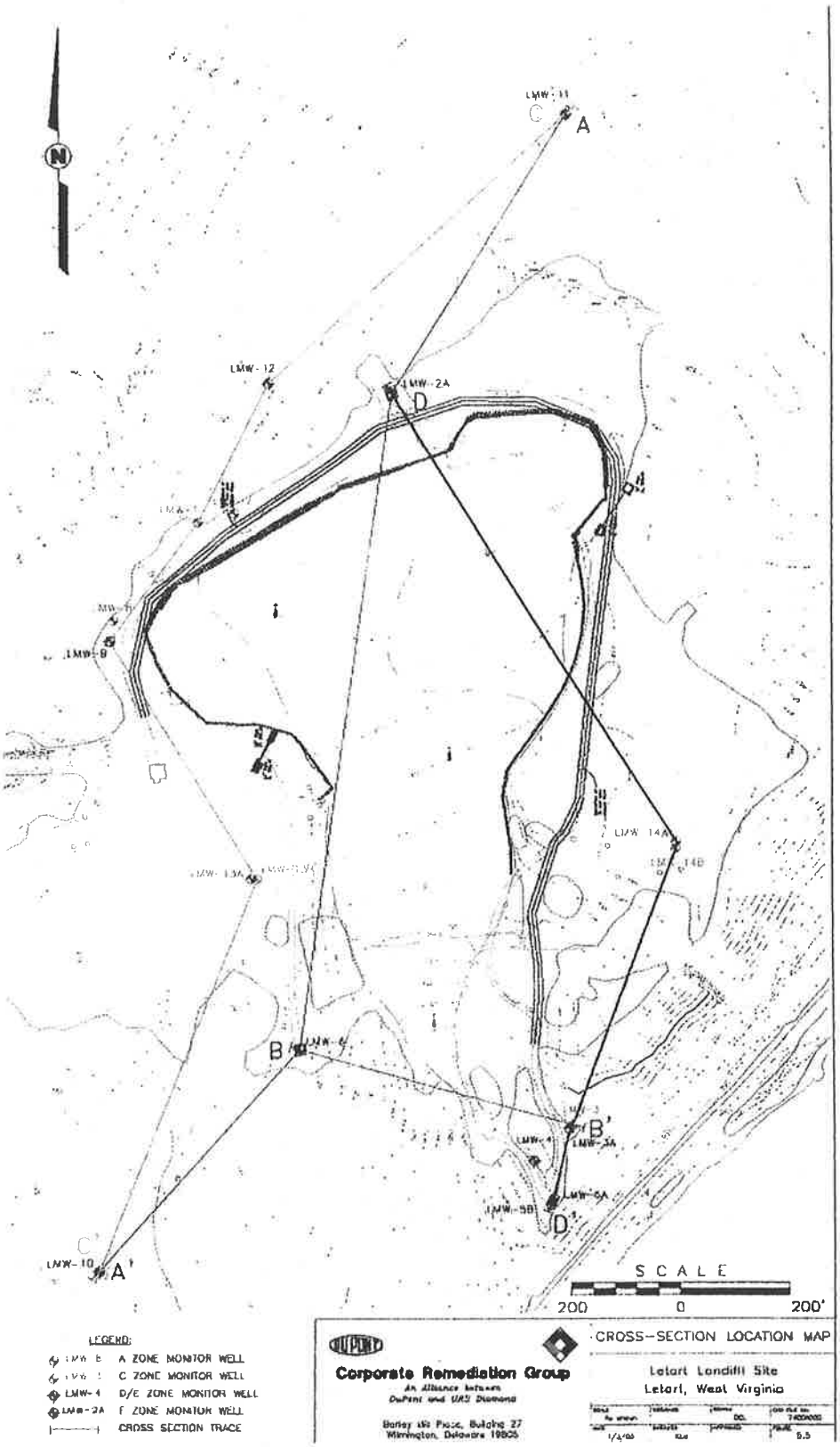

Figure 3.3: Letart Landfill Geological Cross-Section Lines.

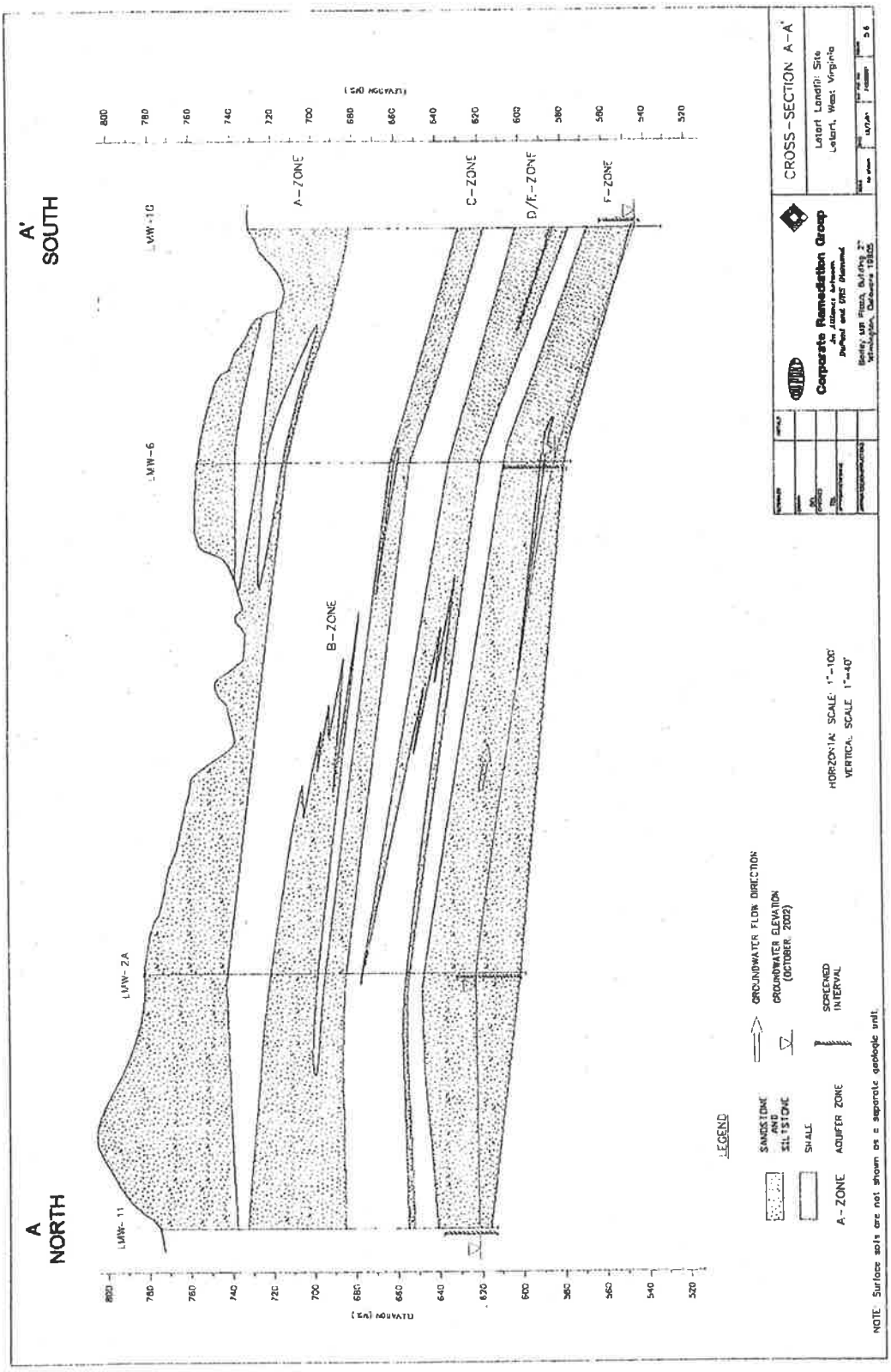

Figure 3.4: Letart Landfill Geological Cross-Section A-A'.

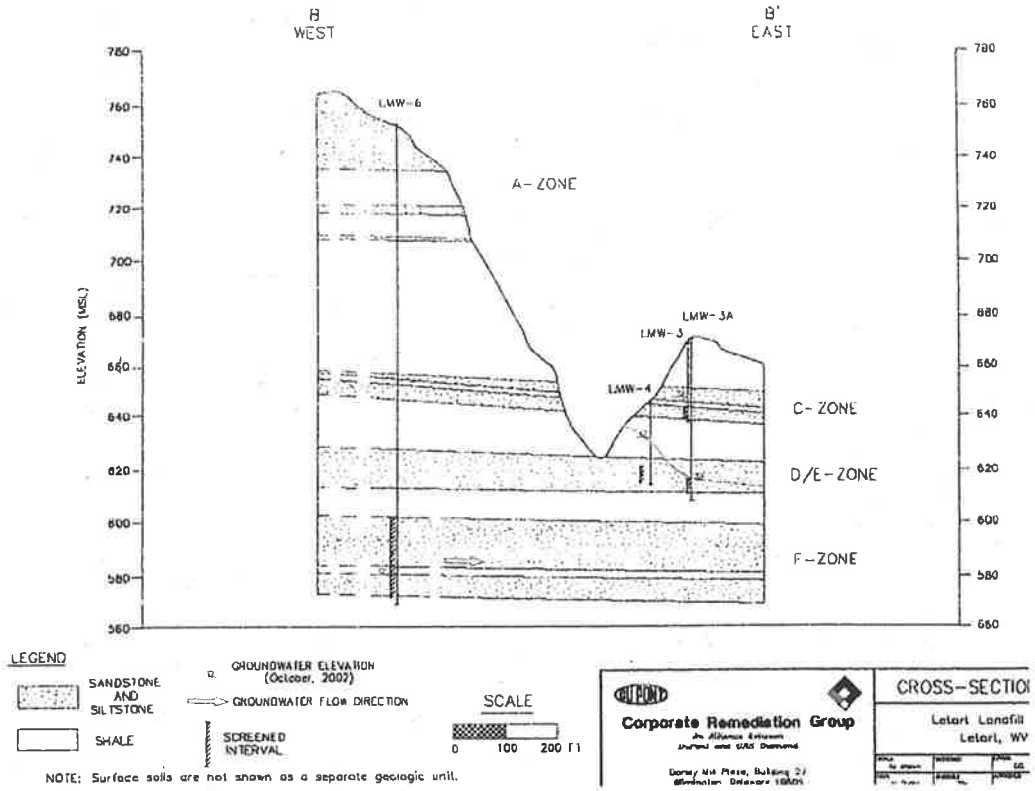

Figure 3.5: Letart Landfill Geological Cross-Section B-B'.

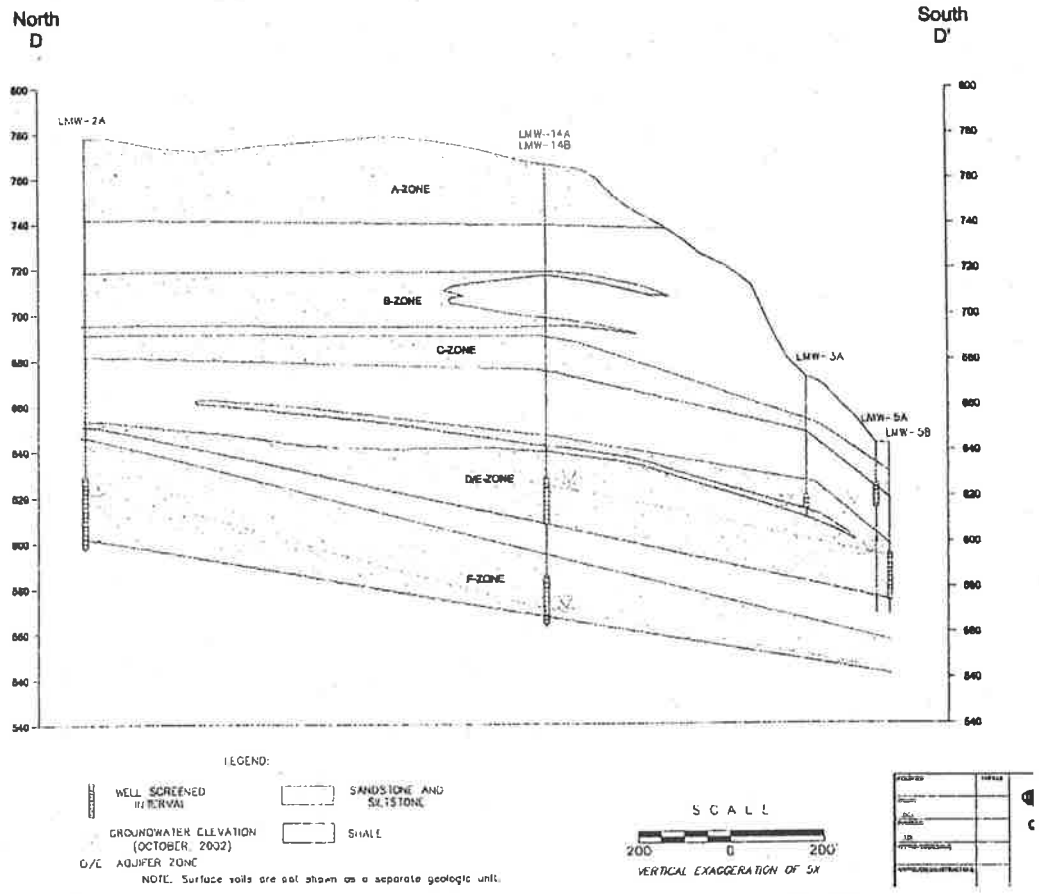

Figure 3.6: Letart Landfill Geological Cross-Section D-D'.

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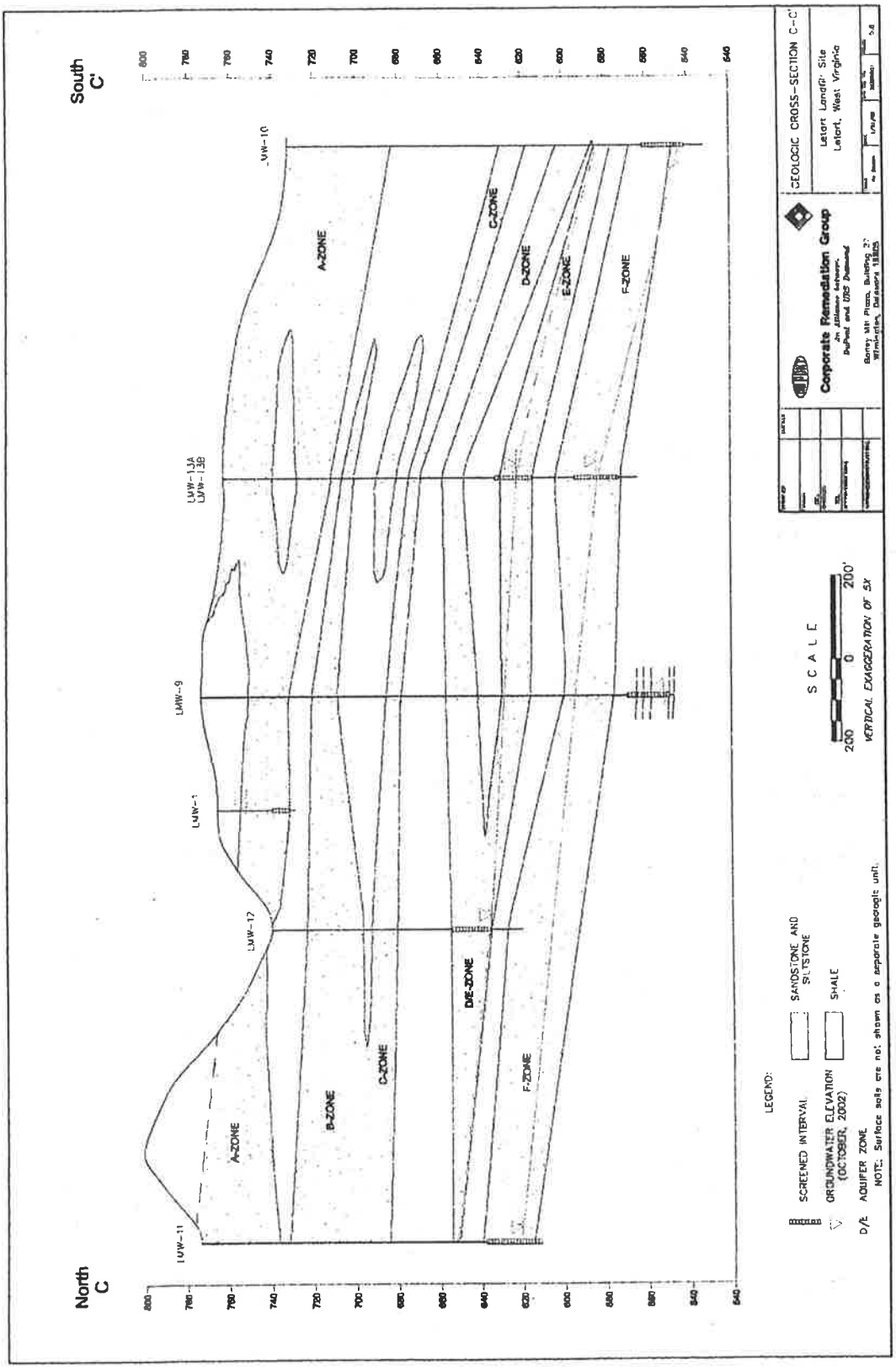


Figure 3.7: Letart Landfill Geological Cross-Section C-C'.

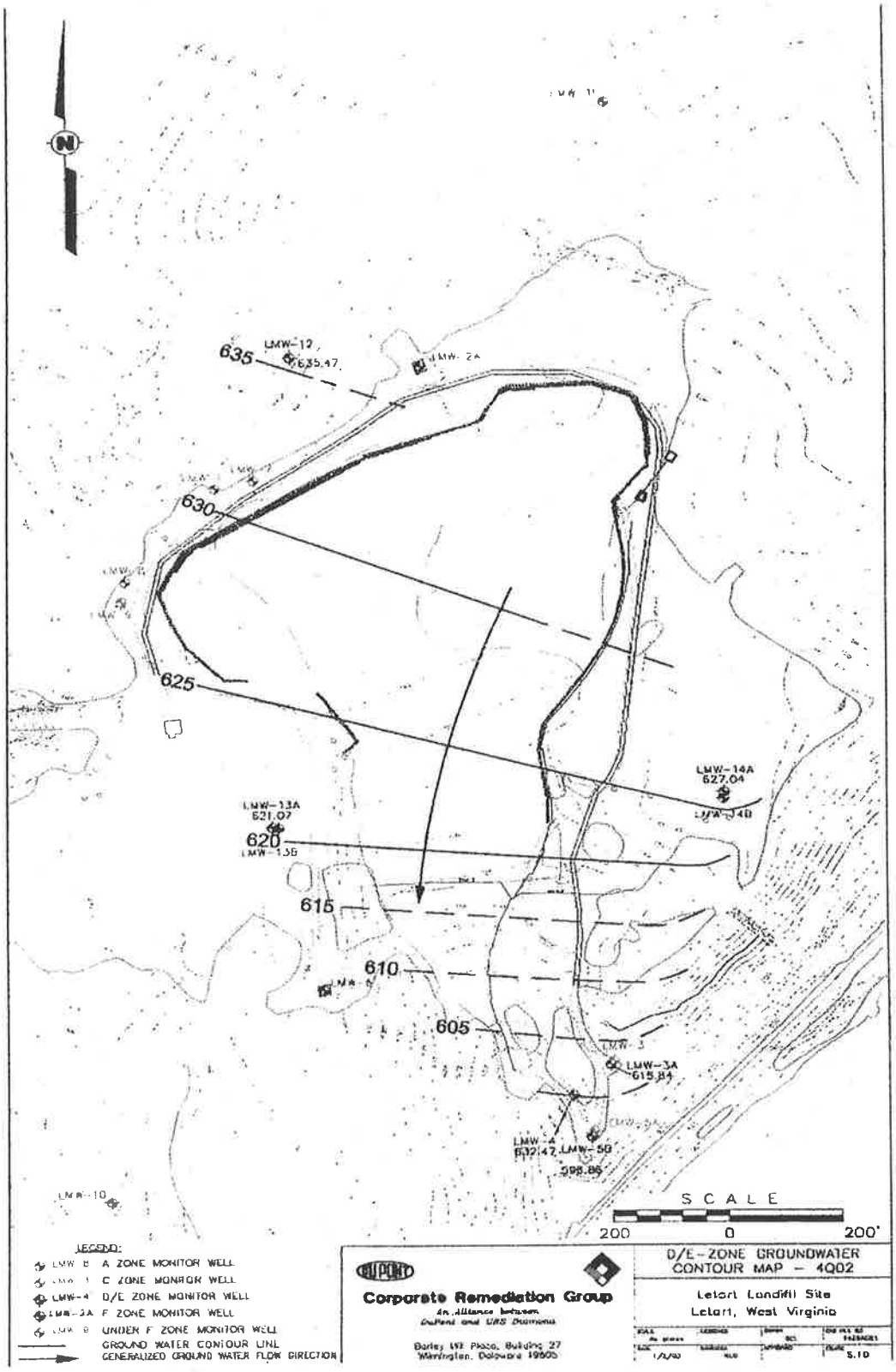


Figure 3.8: Letart Landfill Zone D-E Top-of-Groundwater Map.

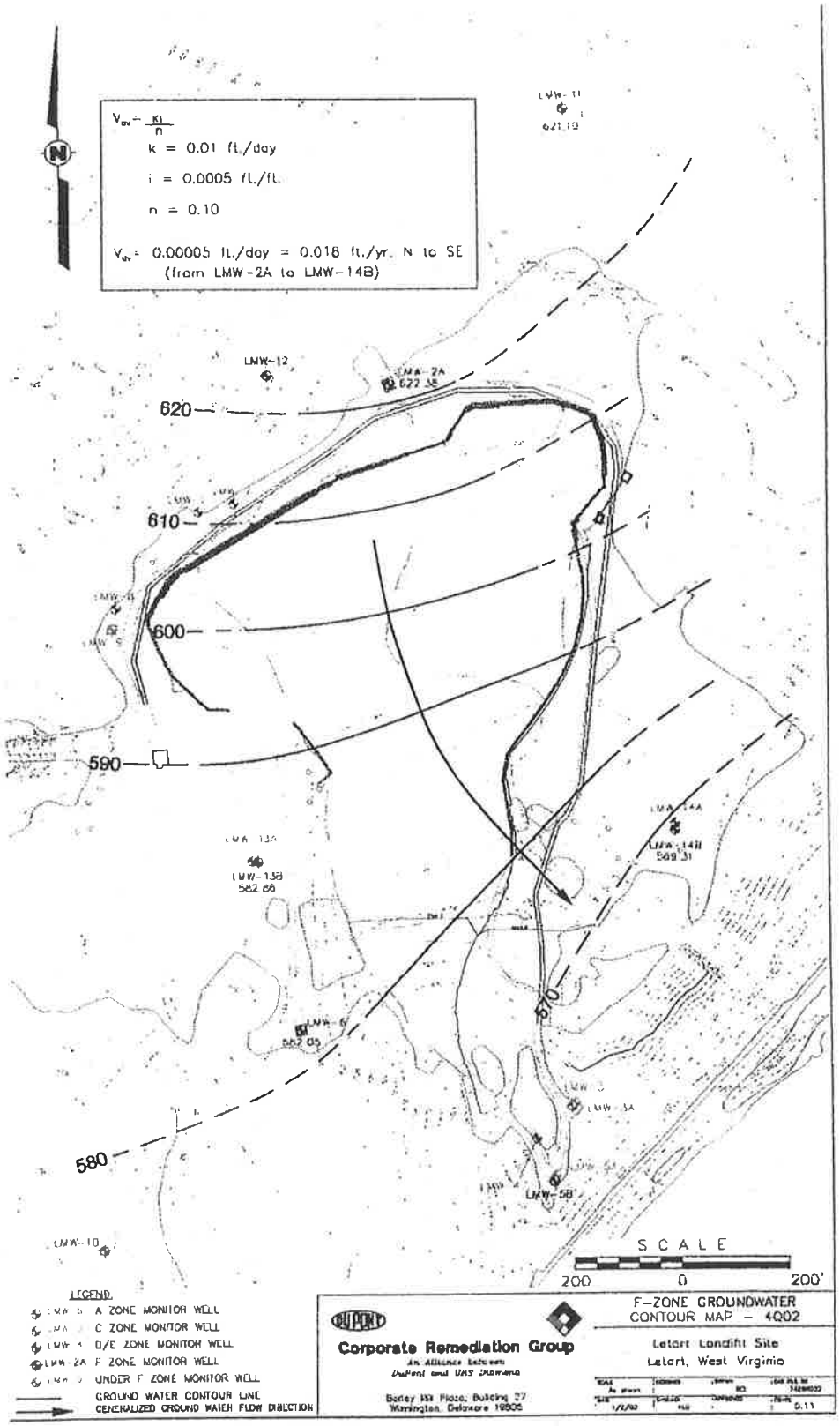


Figure 3.9: Letart Landfill Zone F Top-of-Groundwater Map.

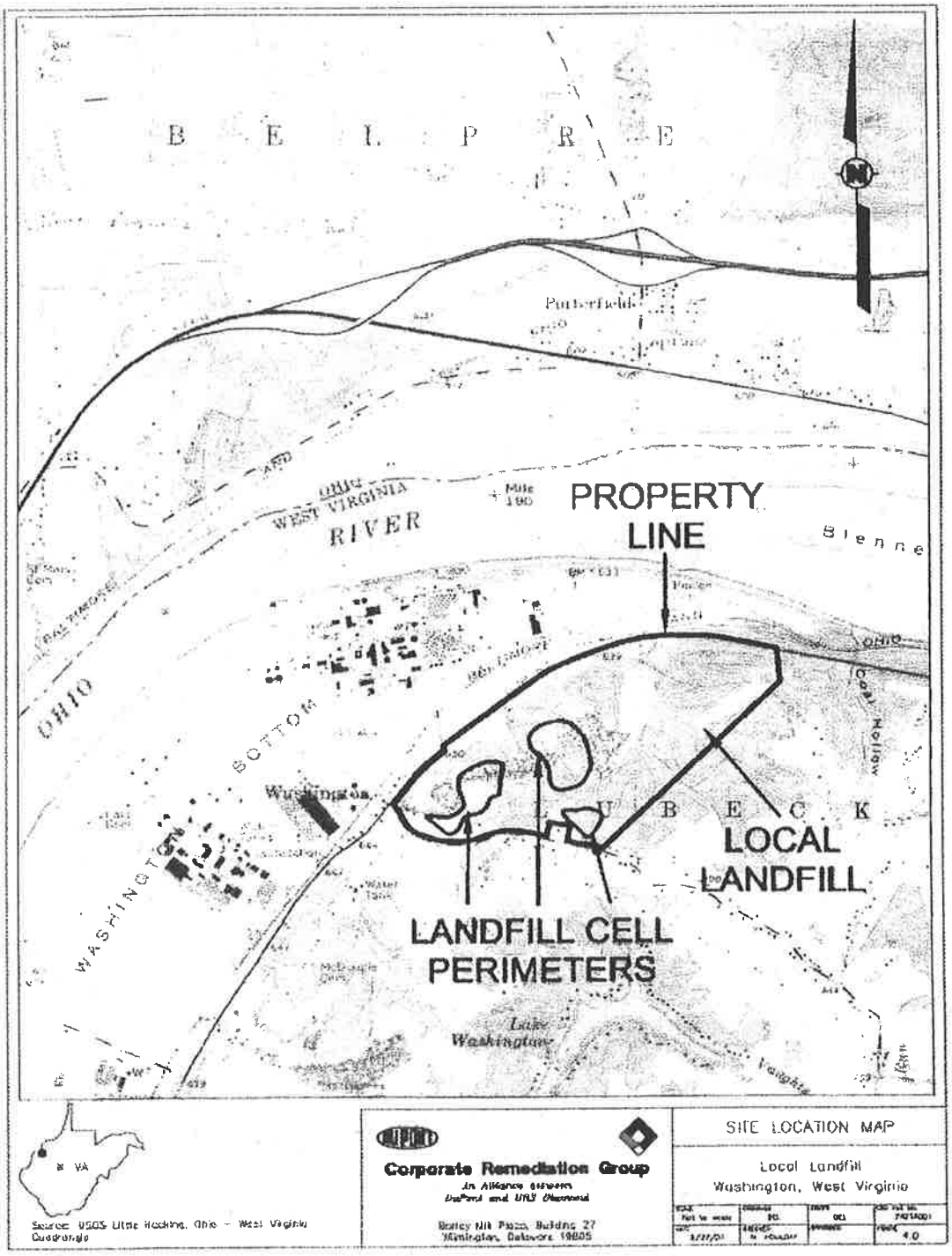


Figure 4.0: Local Landfill Location Map.

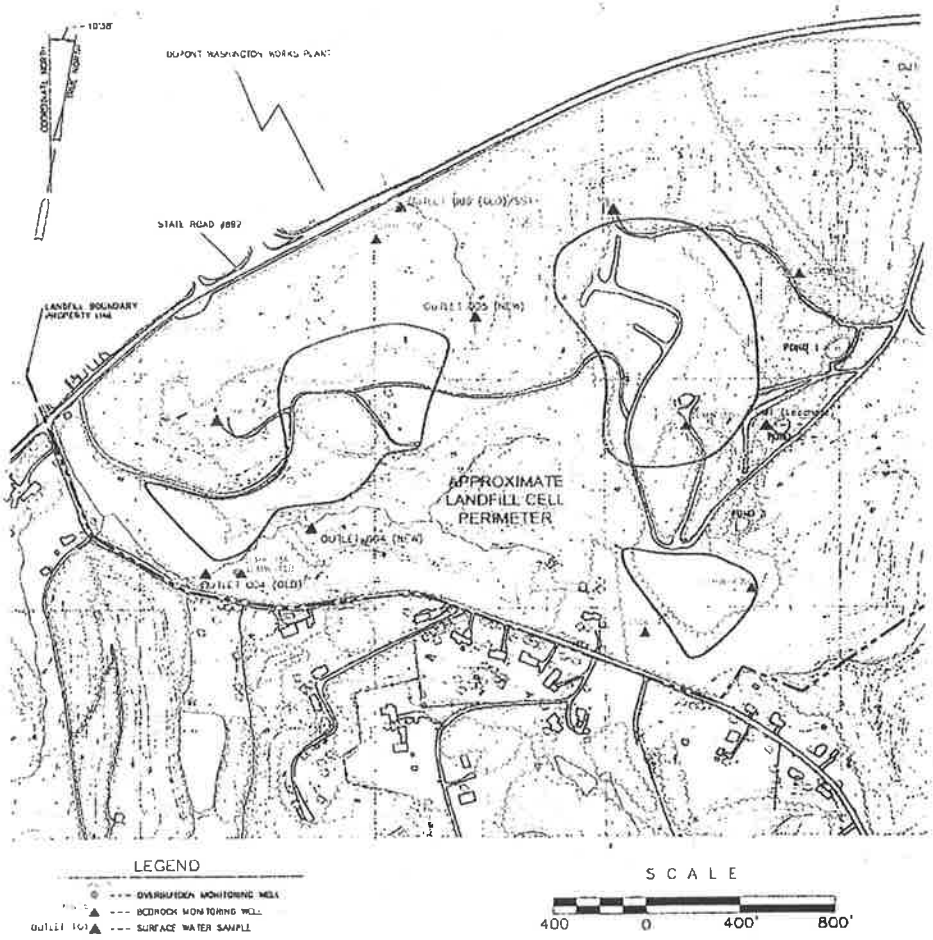


Figure 4.1: Local Landfill with Sampling Points.

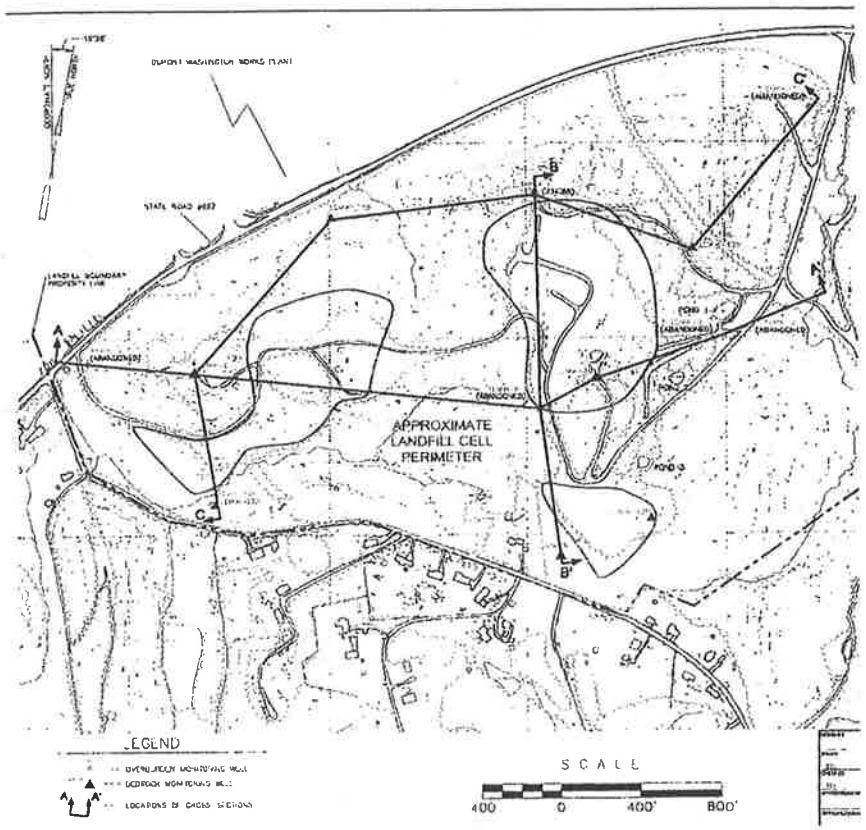


Figure 4.2: Local Landfill Geological Cross-Section Lines.

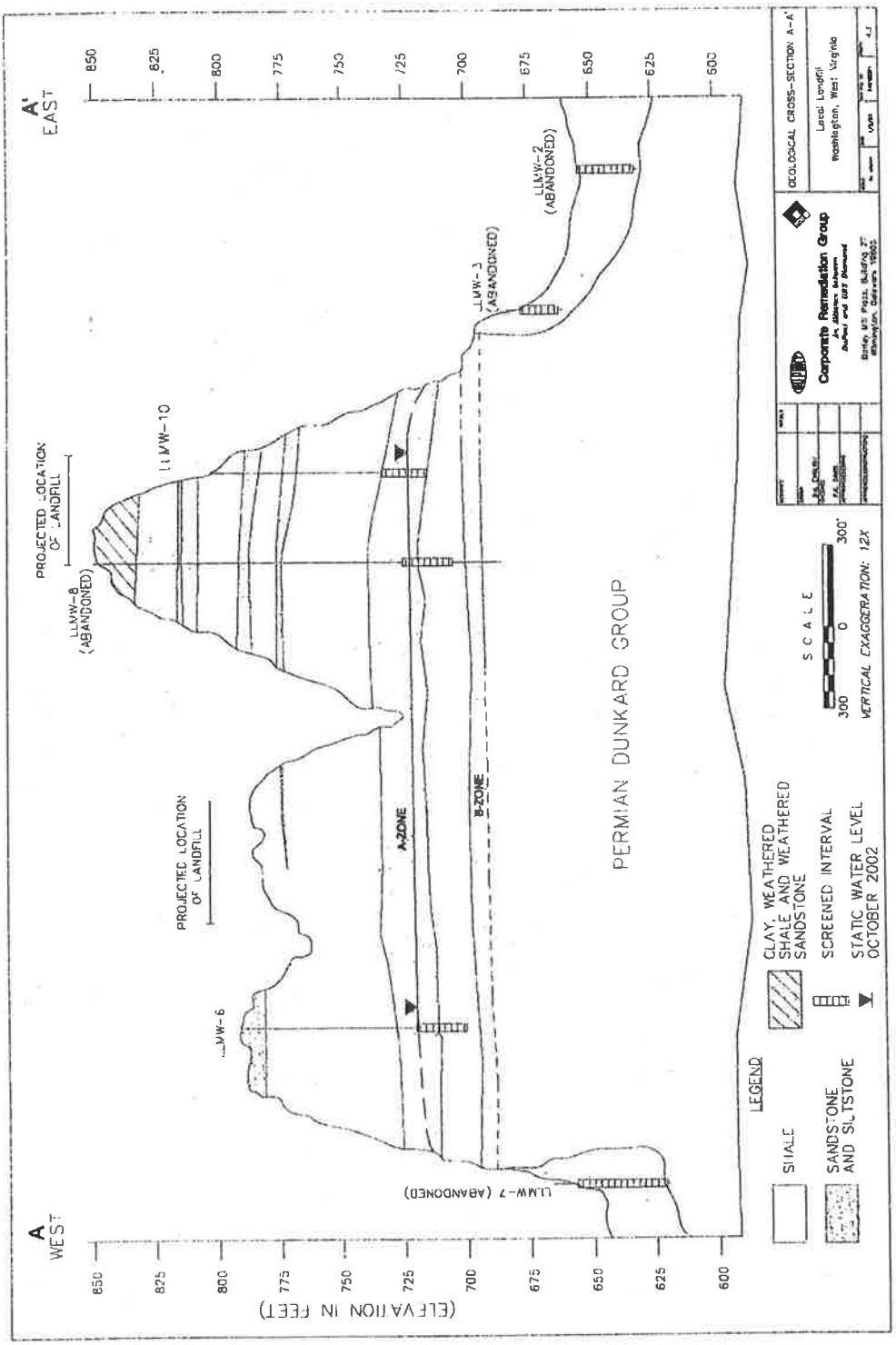


Figure 4.3: Local Landfill Geological Cross-Section A-A'.

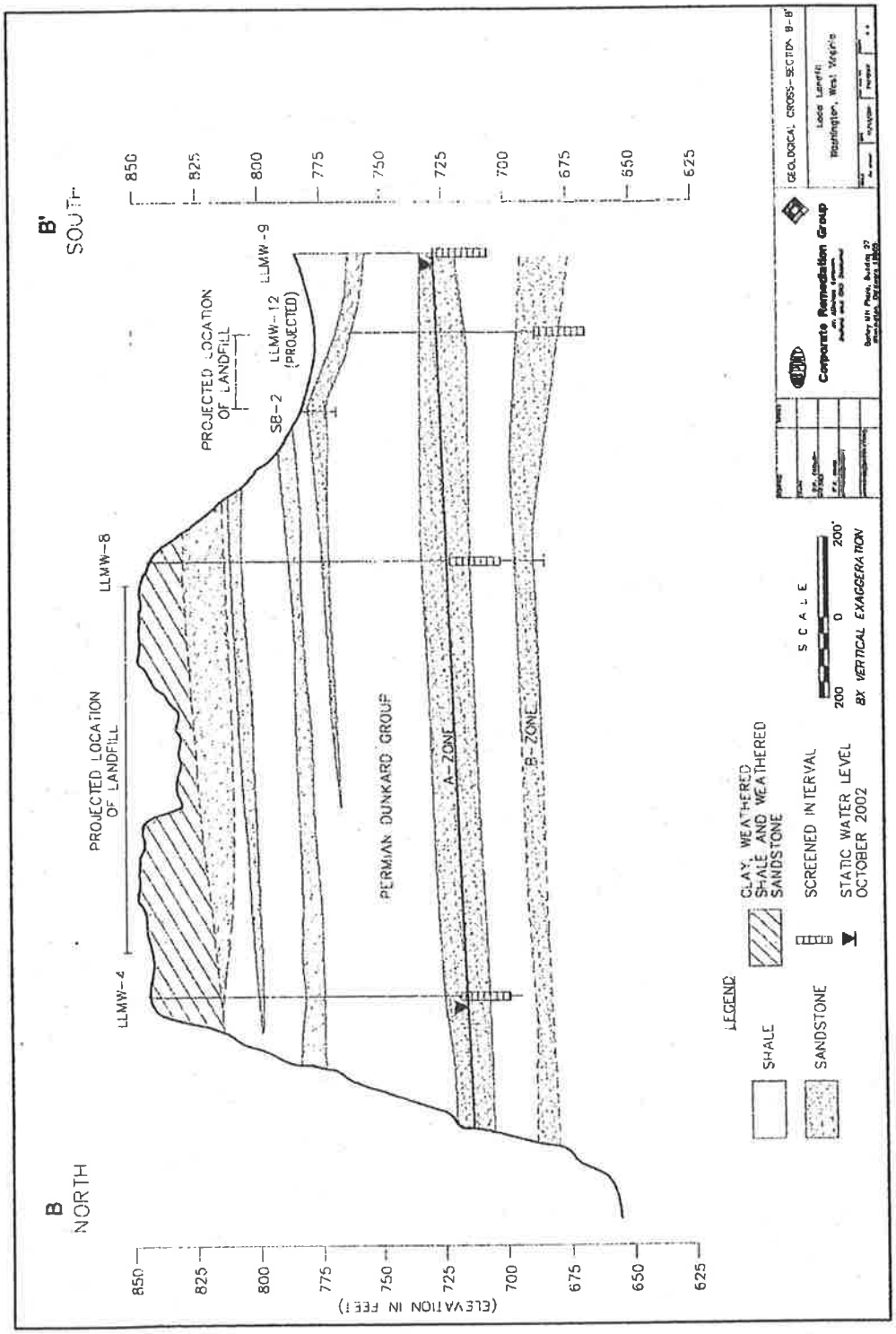


Figure 4.4: Local Landfill Geological Cross-Section B-B'.

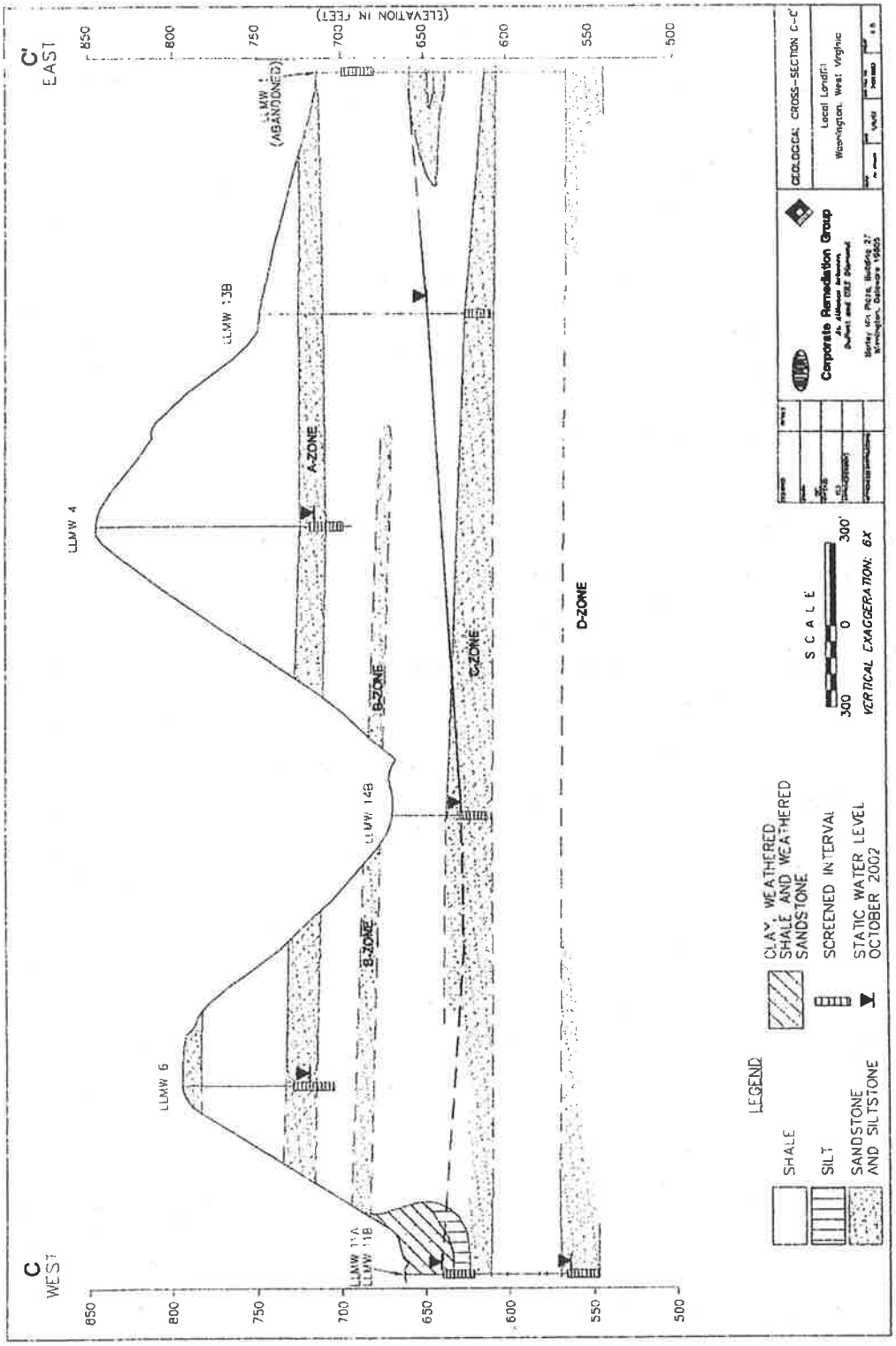


Figure 4.5: Local Landfill Geological Cross-Section C-C'.

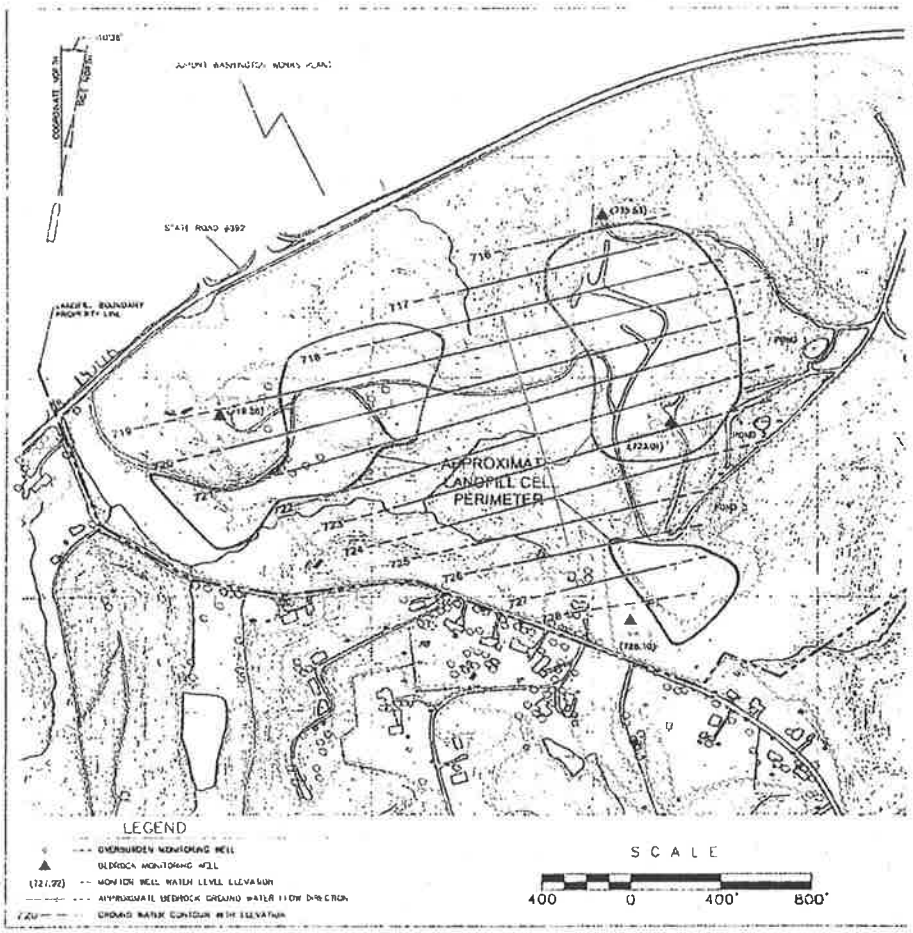


Figure 4.6: Local Landfill Zone A Top-of-Groundwater Map.

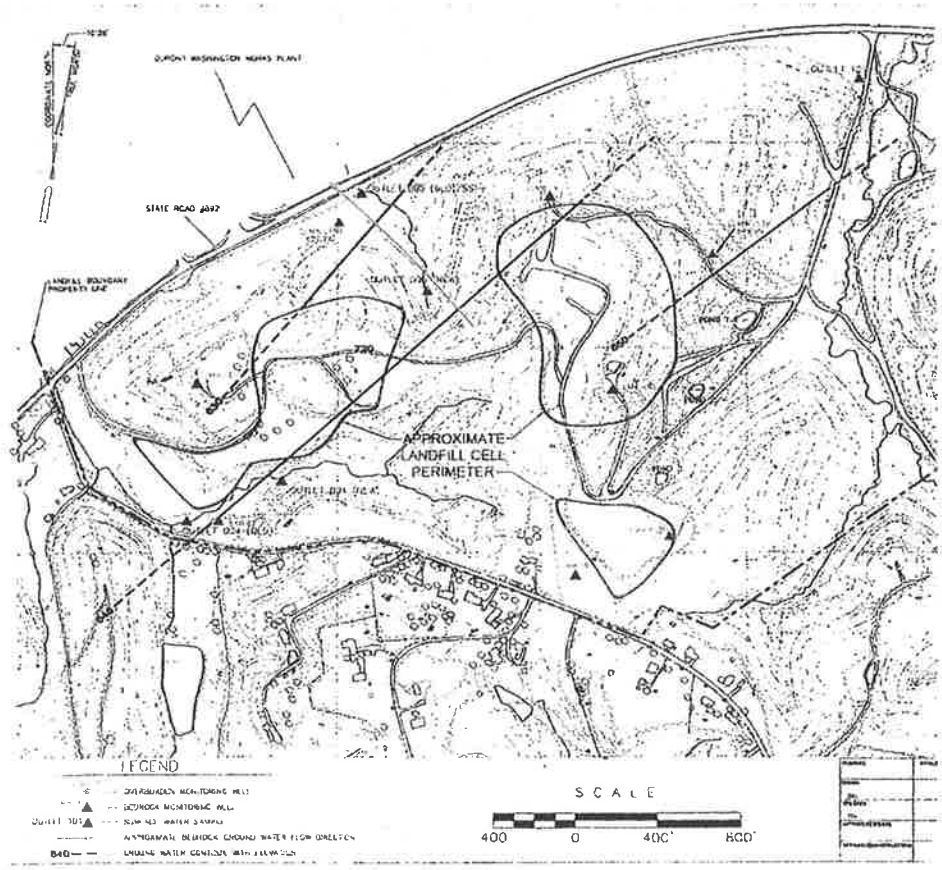


Figure 4.7: Local Landfill Zone C Top-of-Groundwater Map.

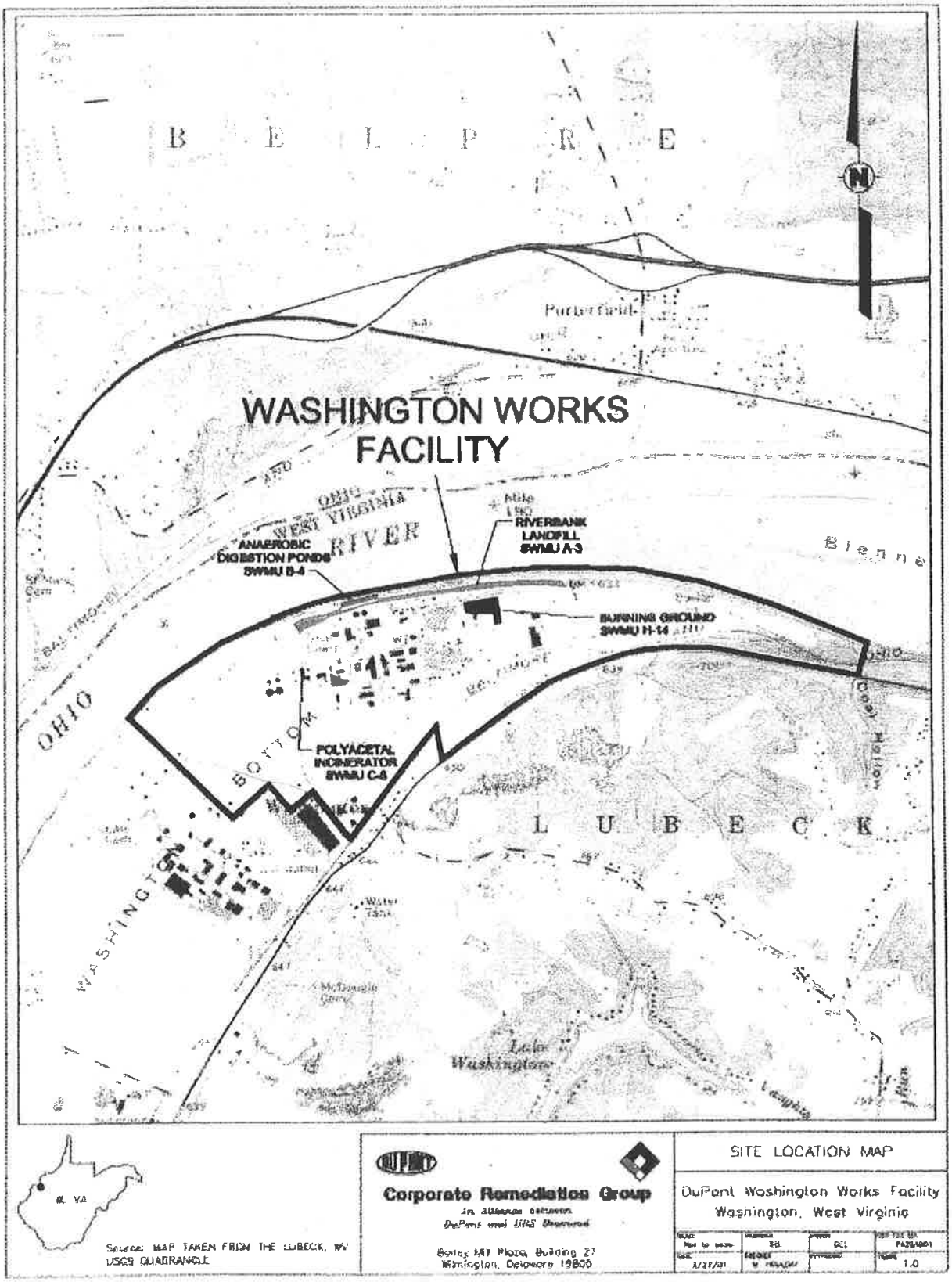


Figure 5.0: Washington Works Plant Location Map.

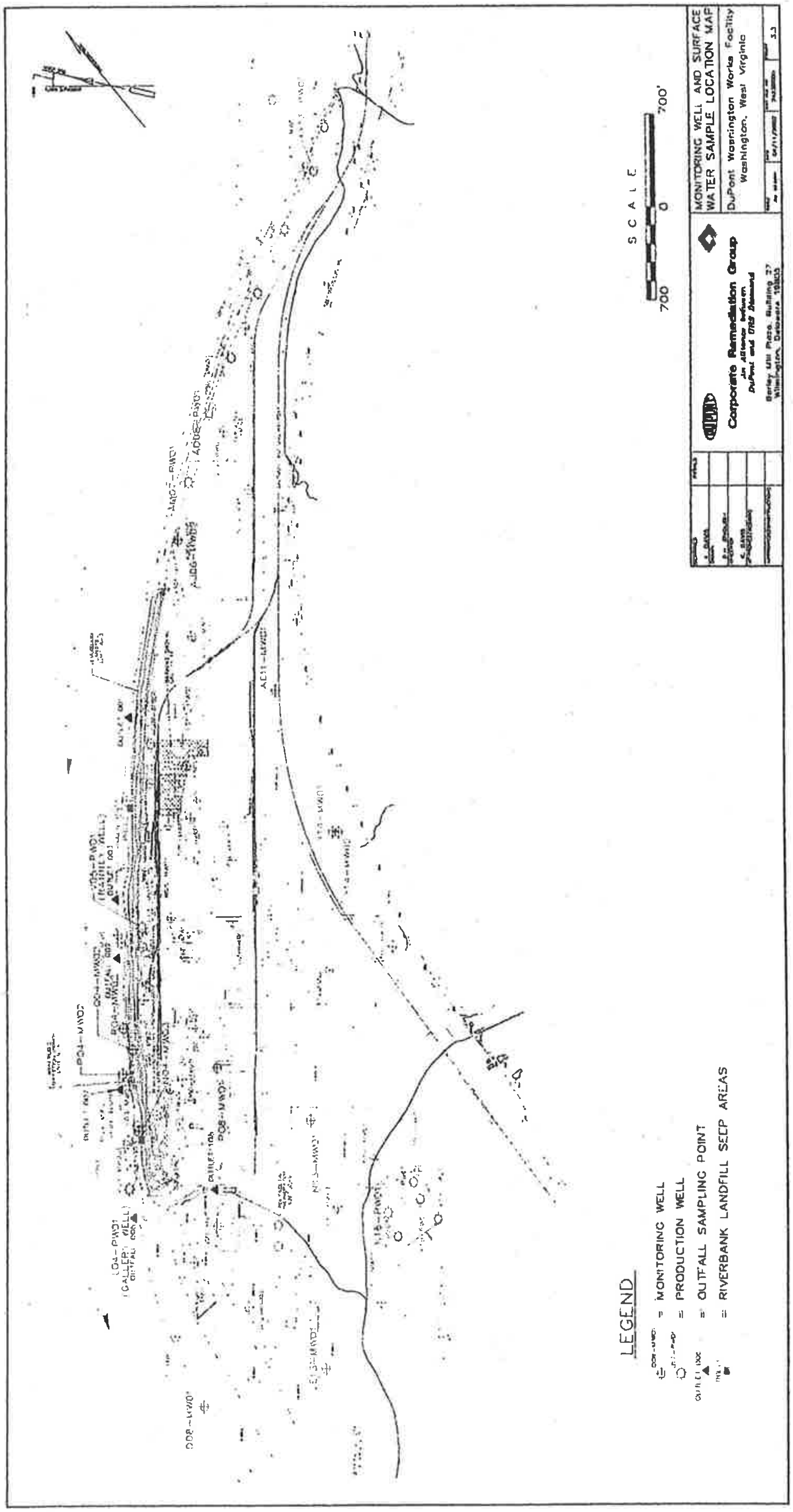


Figure 5.1: Washington Works Facility Sampling Points.

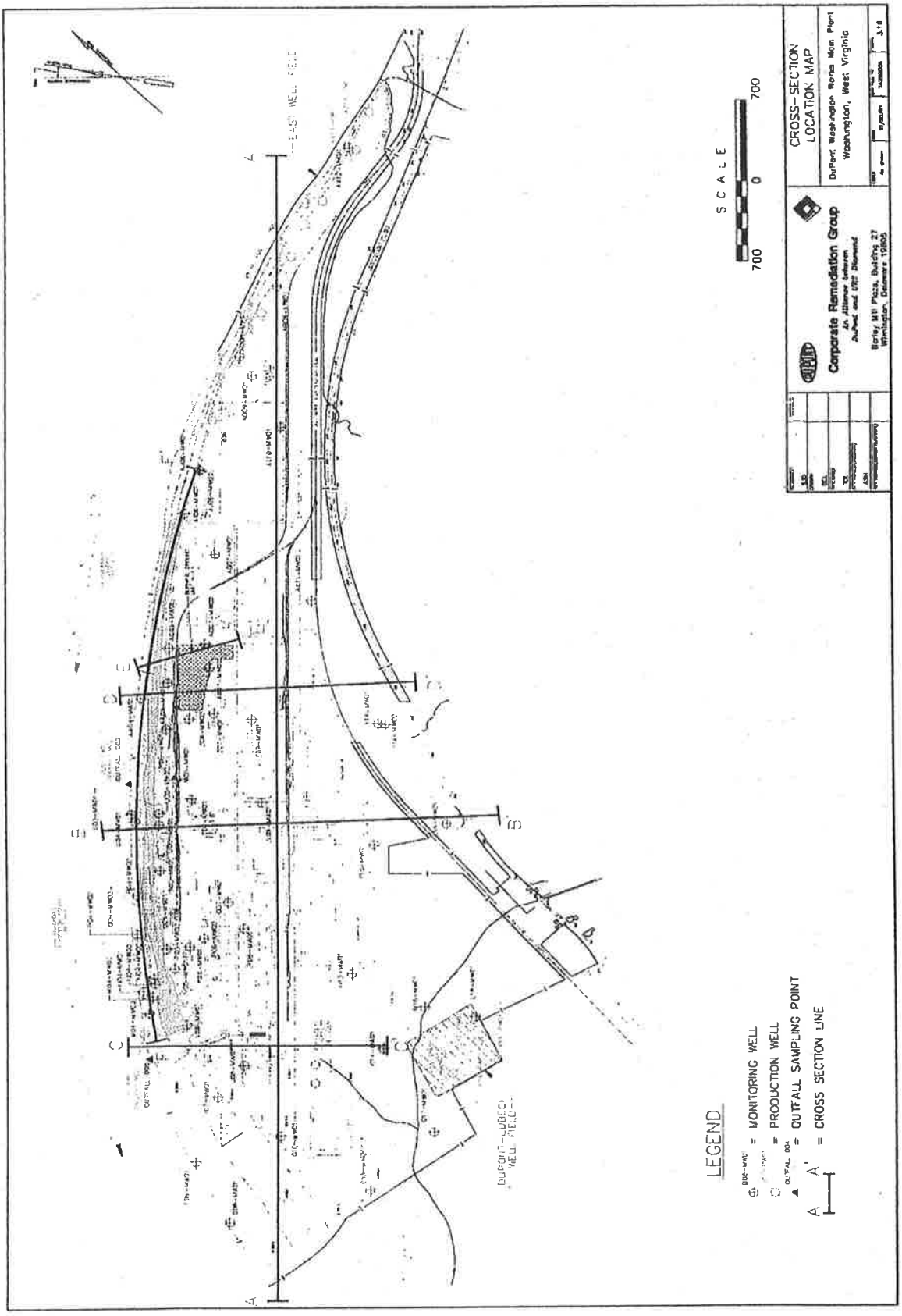


Figure 5.2: Washington Works Facility Geological Cross-Section Lines.

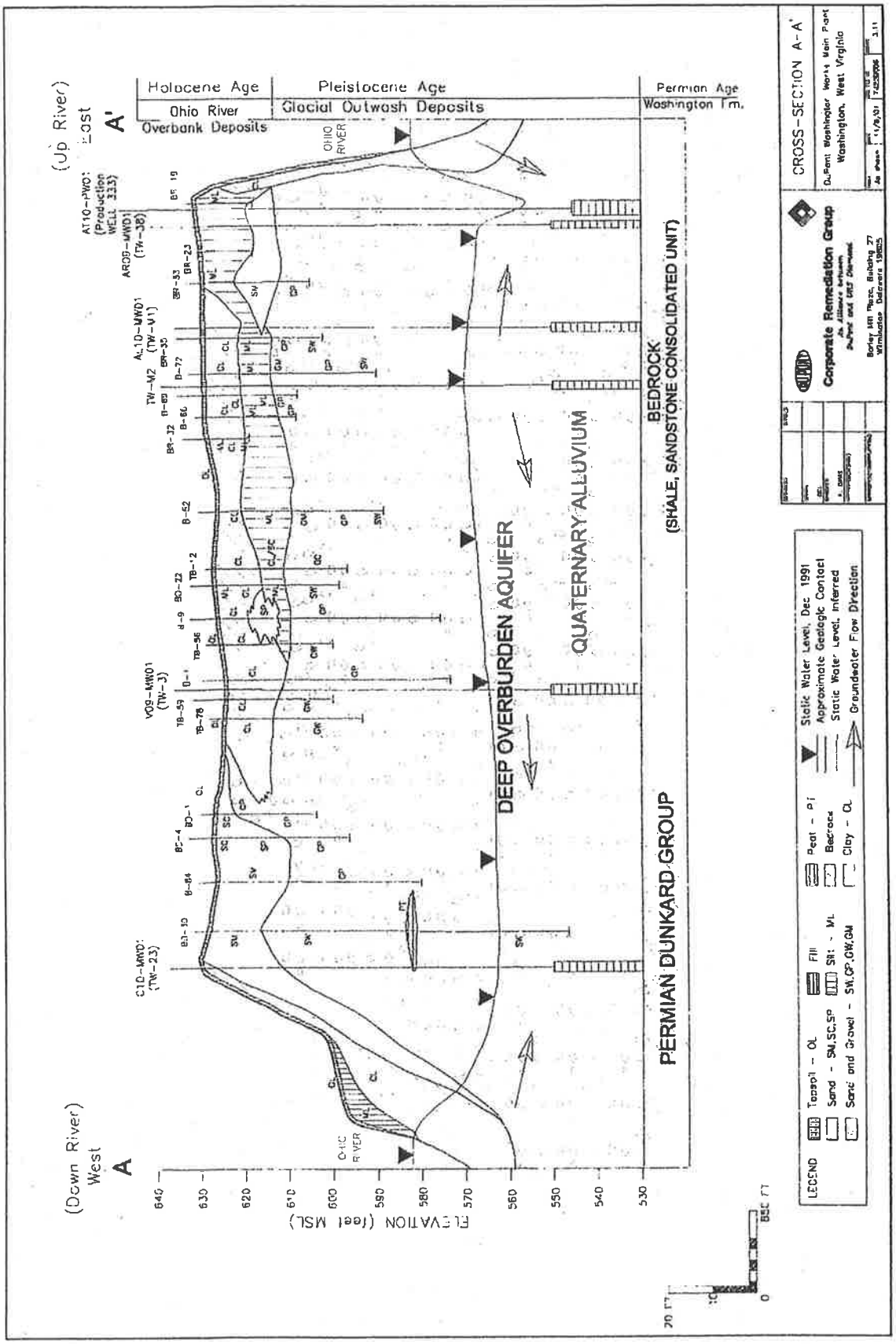


Figure 5.3: Washington Works Facility Geological Cross-Section A-A'.

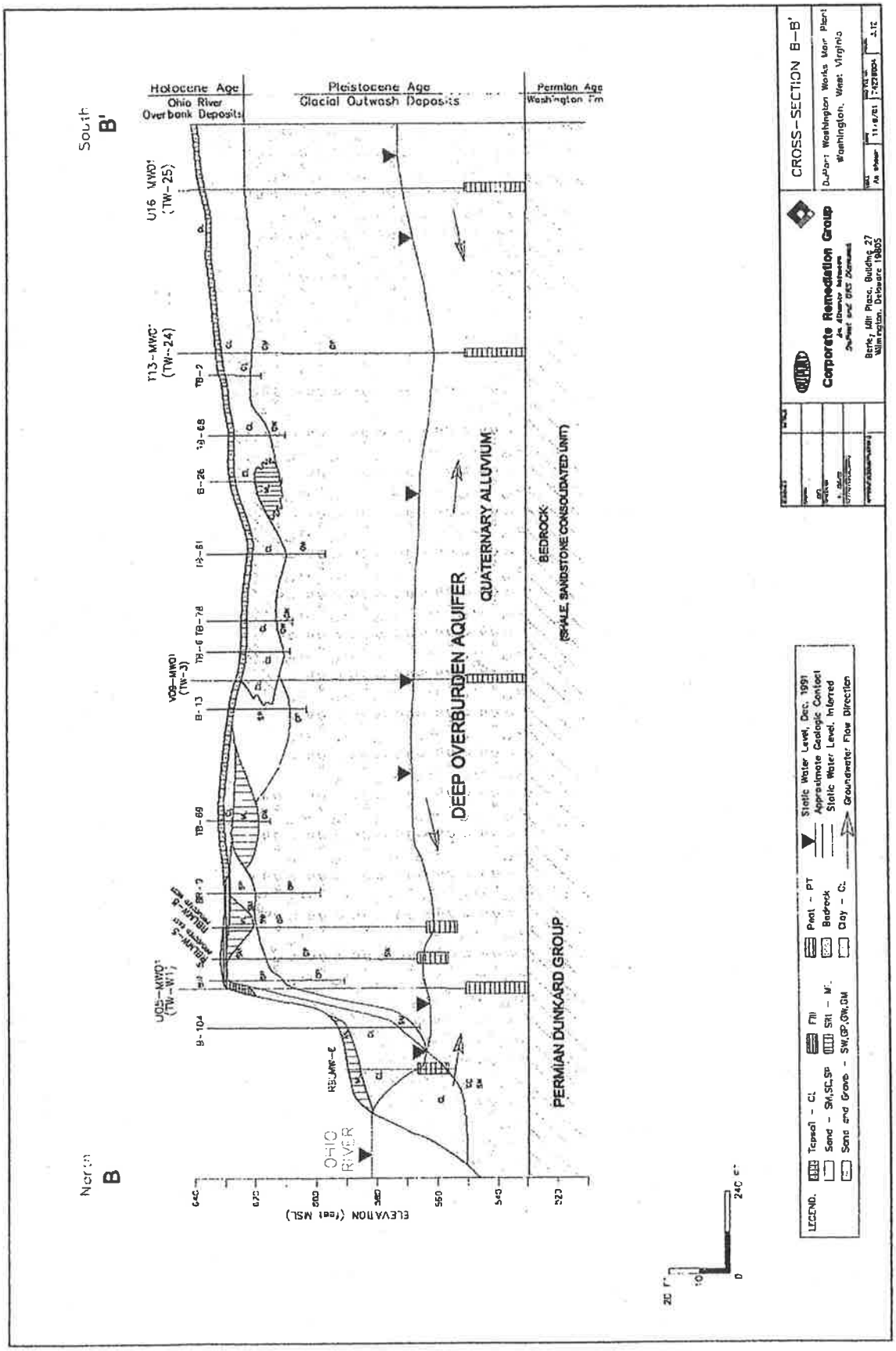


Figure 5.4: Washington Works Facility Geological Cross-Section B-B'.

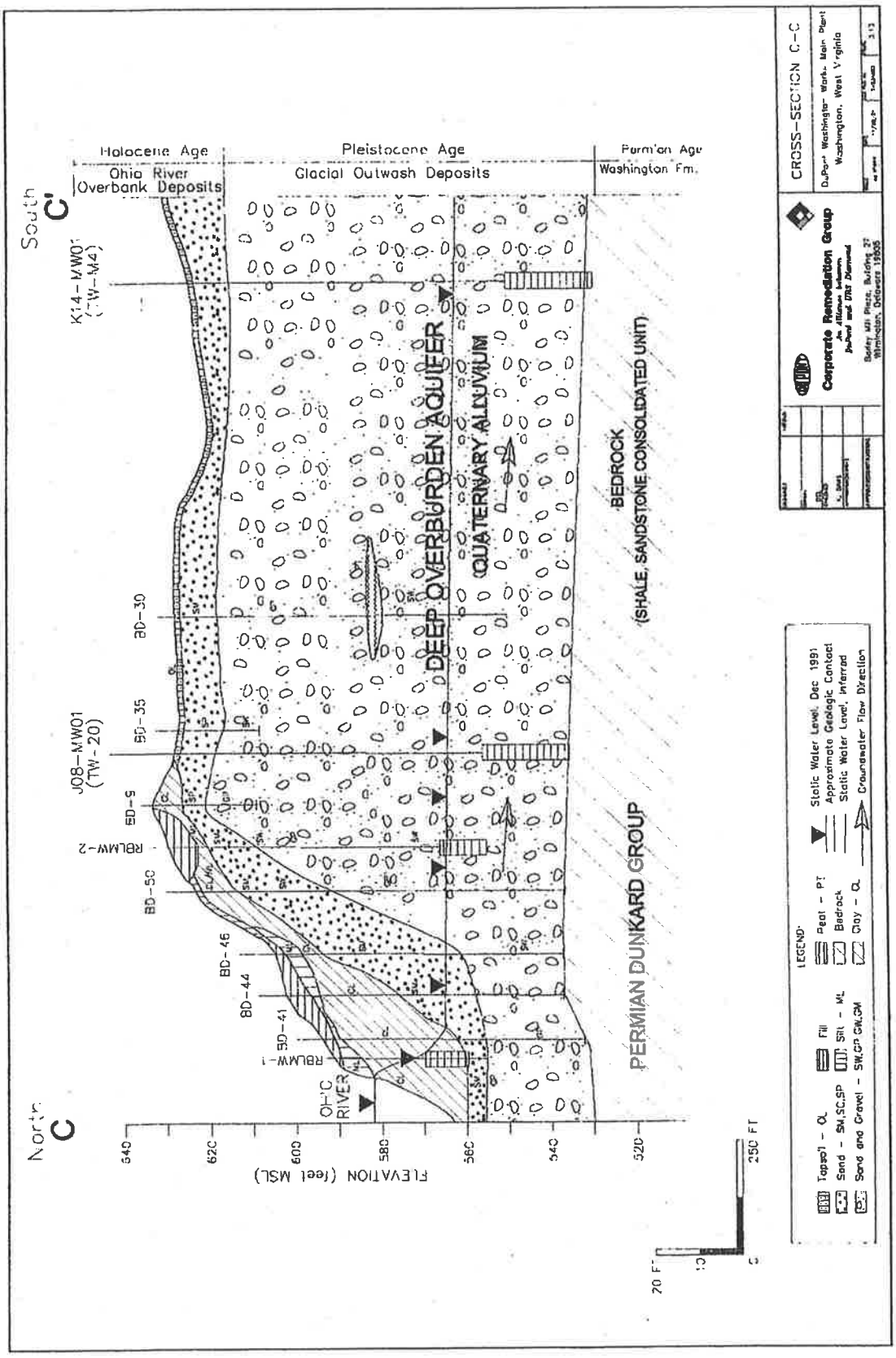


Figure 5.5: Washington Works Facility Geological Cross-Section C-C'.

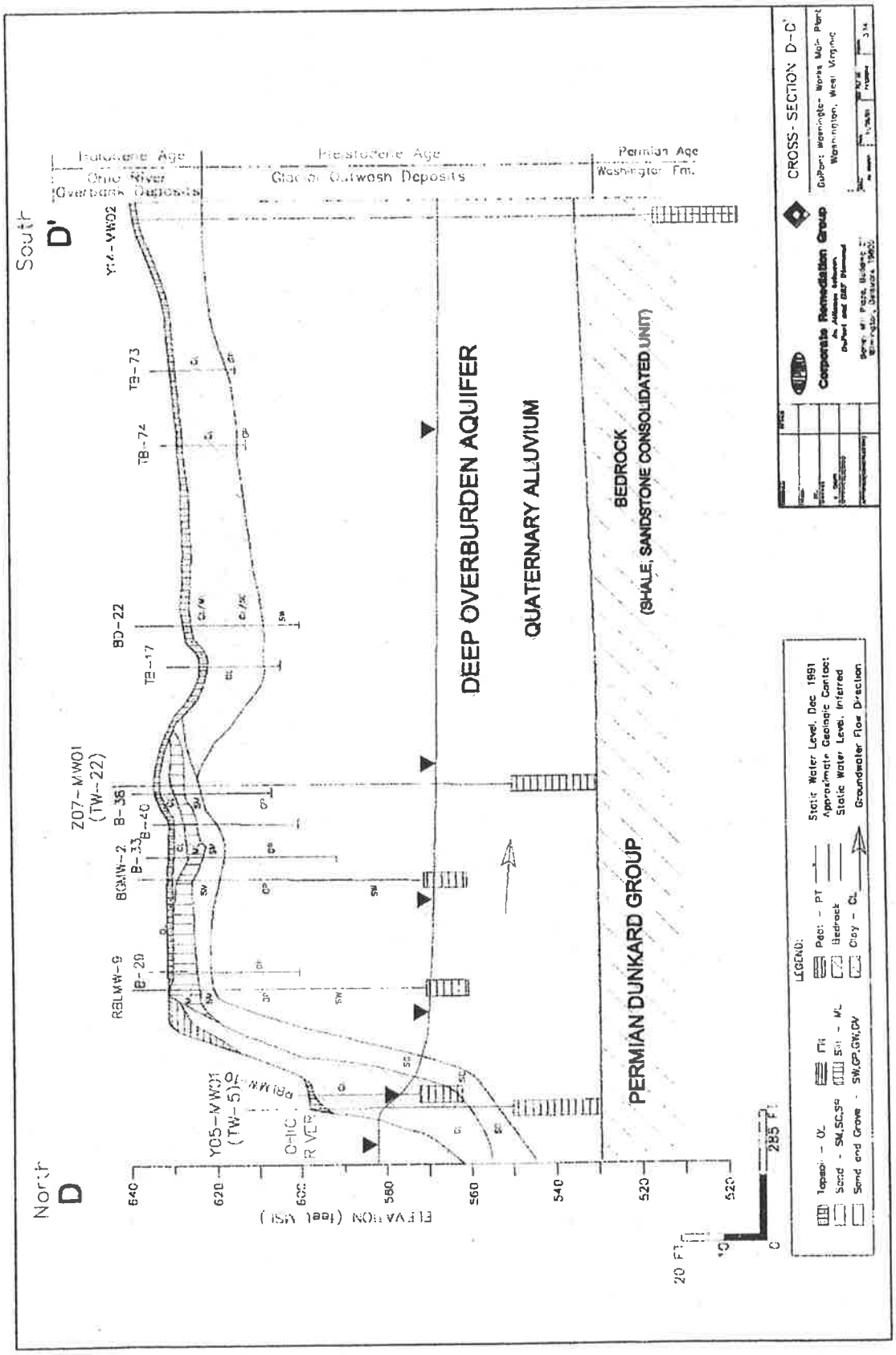


Figure 5.6: Washington Works Facility Geological Cross-Section D-D'.

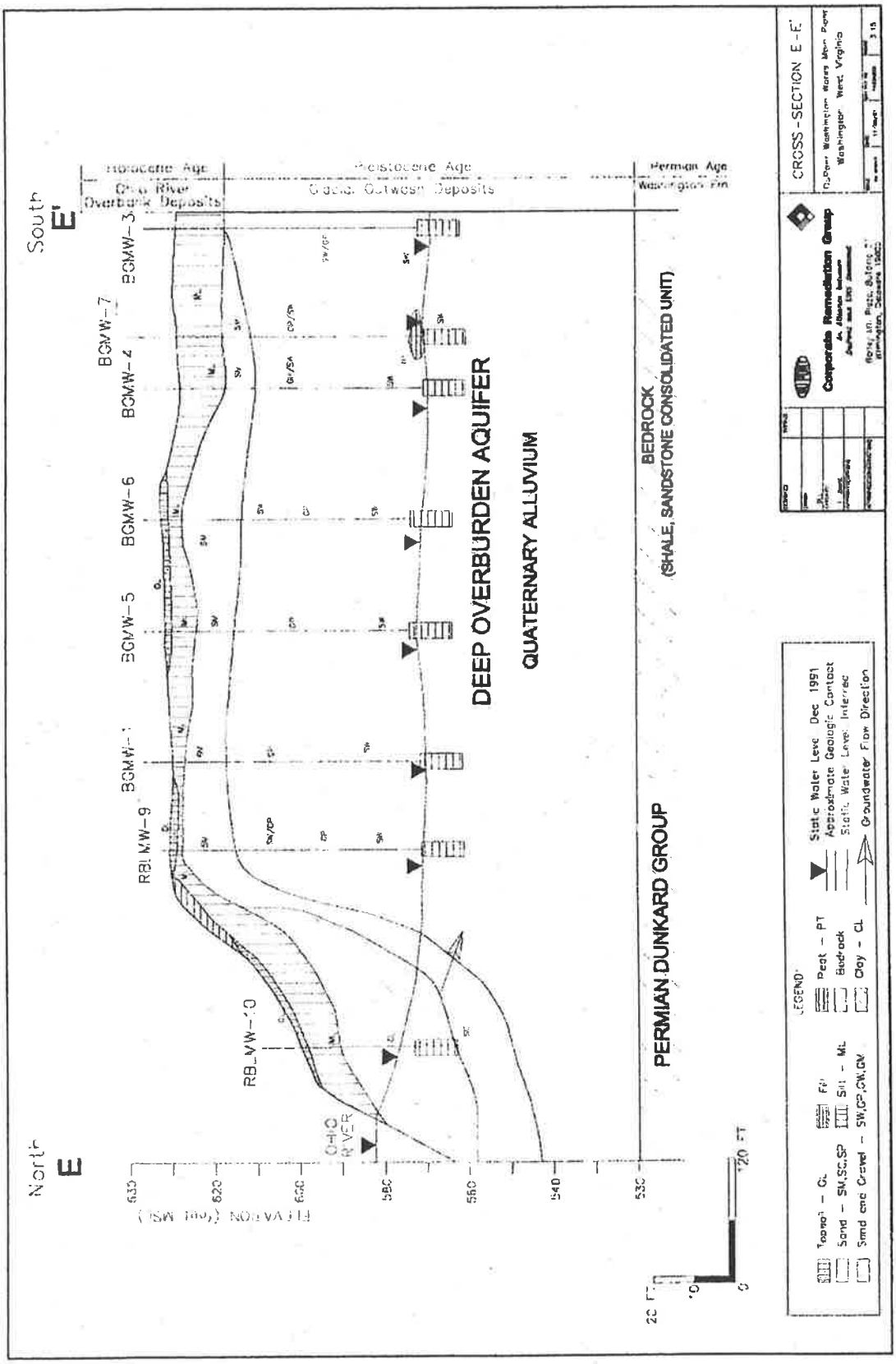


Figure 5.7: Washington Works Facility Geological Cross-Section E-E'.

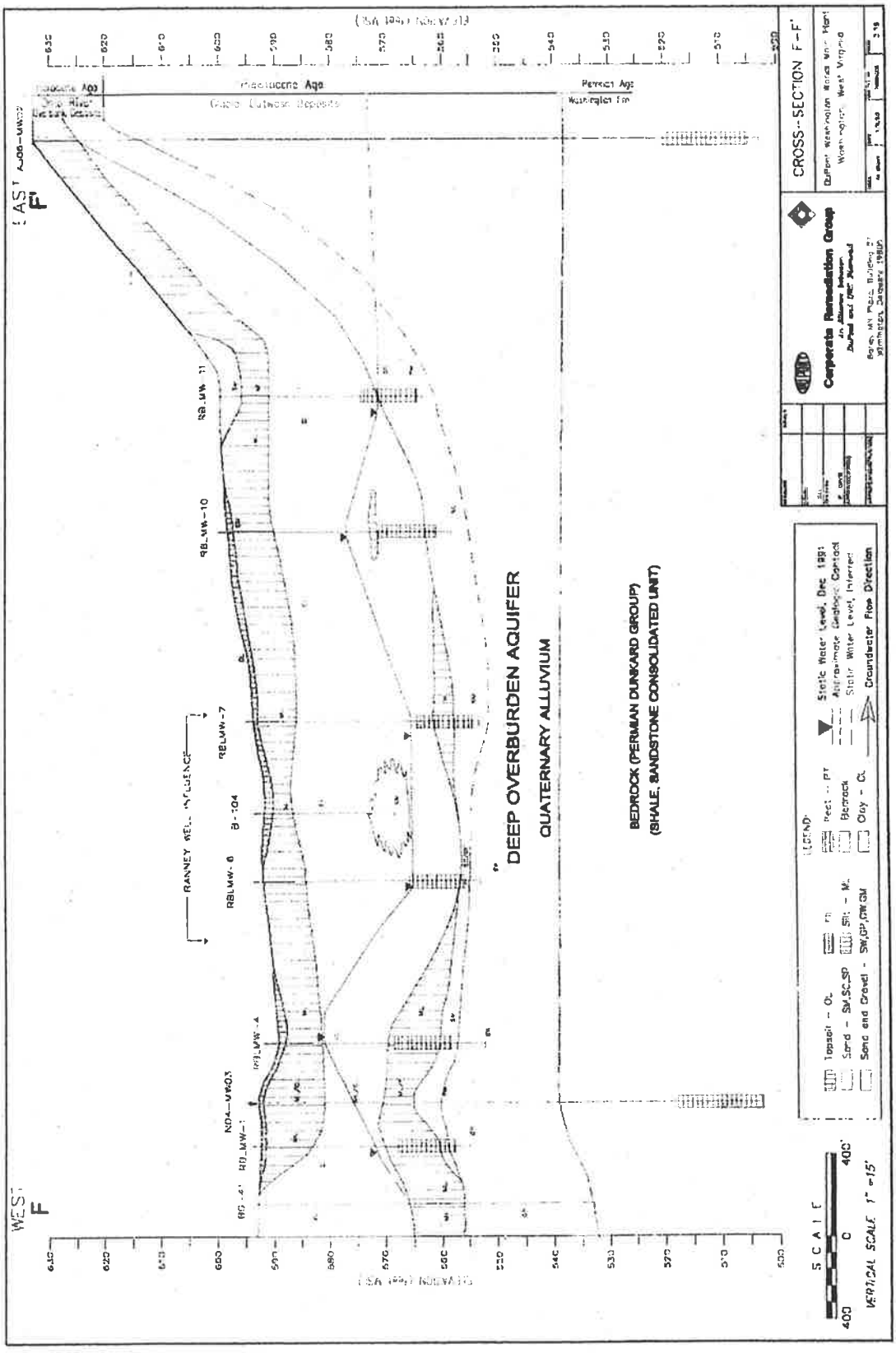


Figure 5.8: Washington Works Facility Geological Cross-Section F-F'.

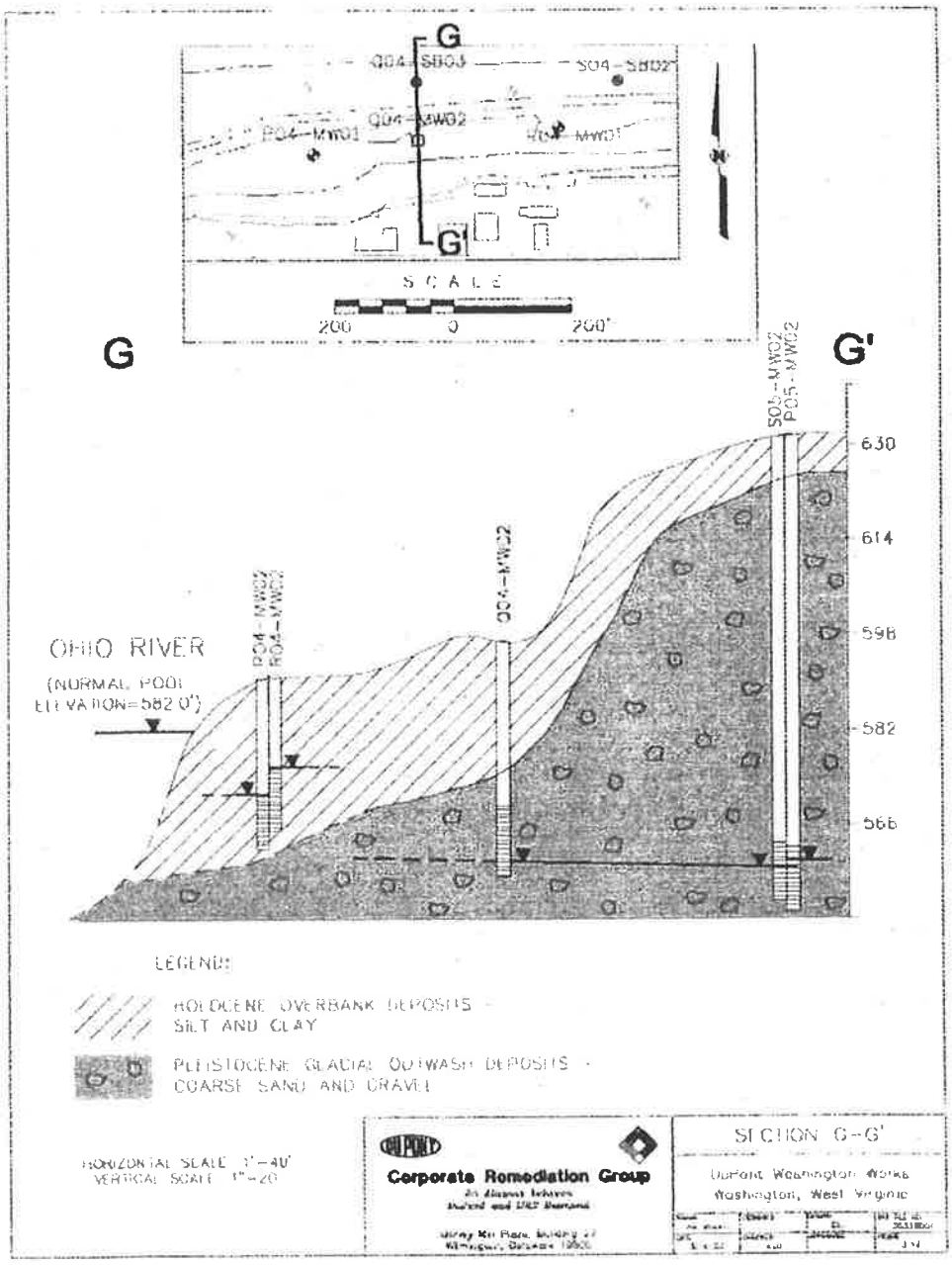


Figure 5.9: Washington Works Facility Geological Cross-Section G-G'.

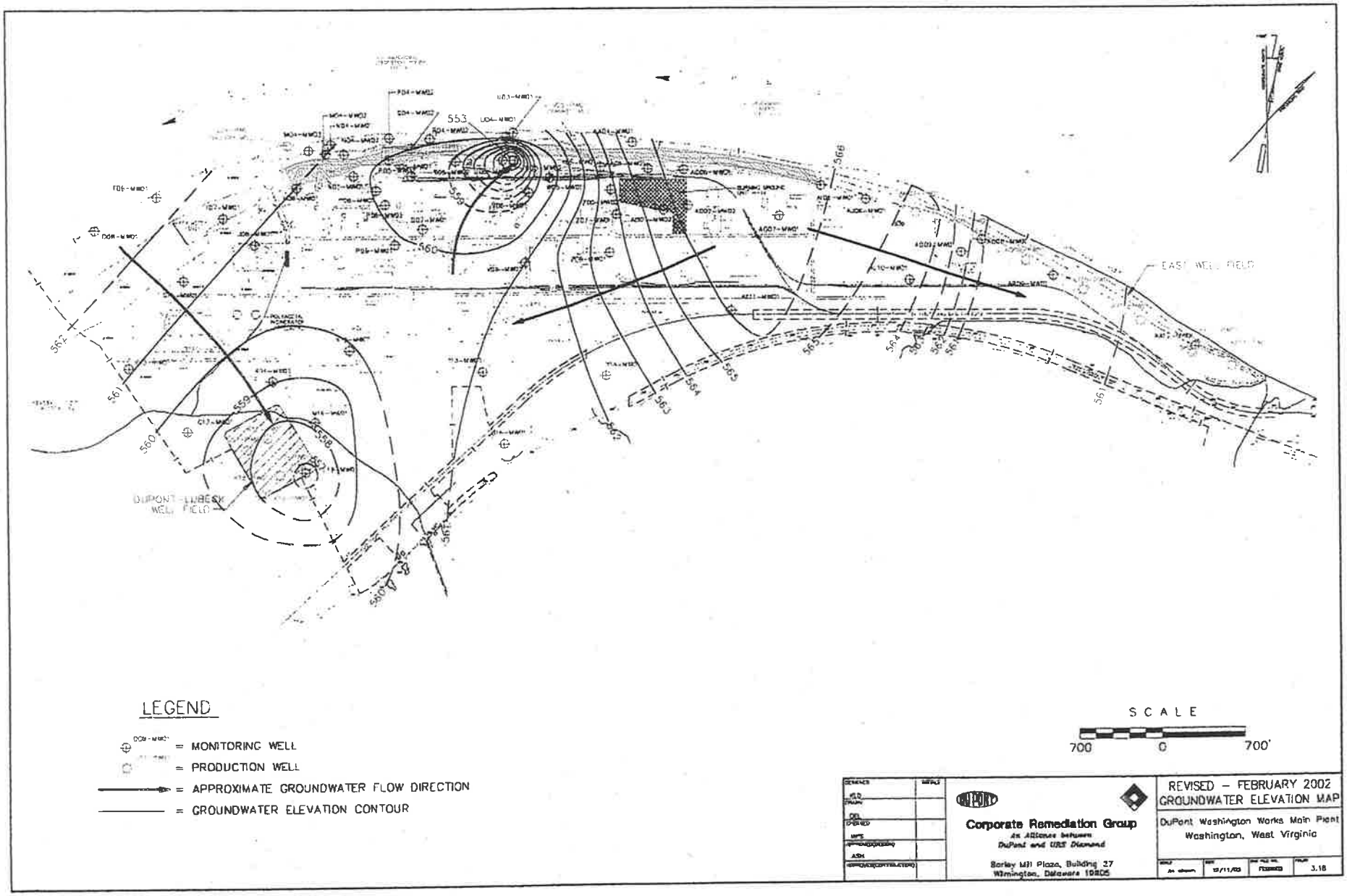


Figure 5.10: Washington Works Facility Top-of-Groundwater Map.

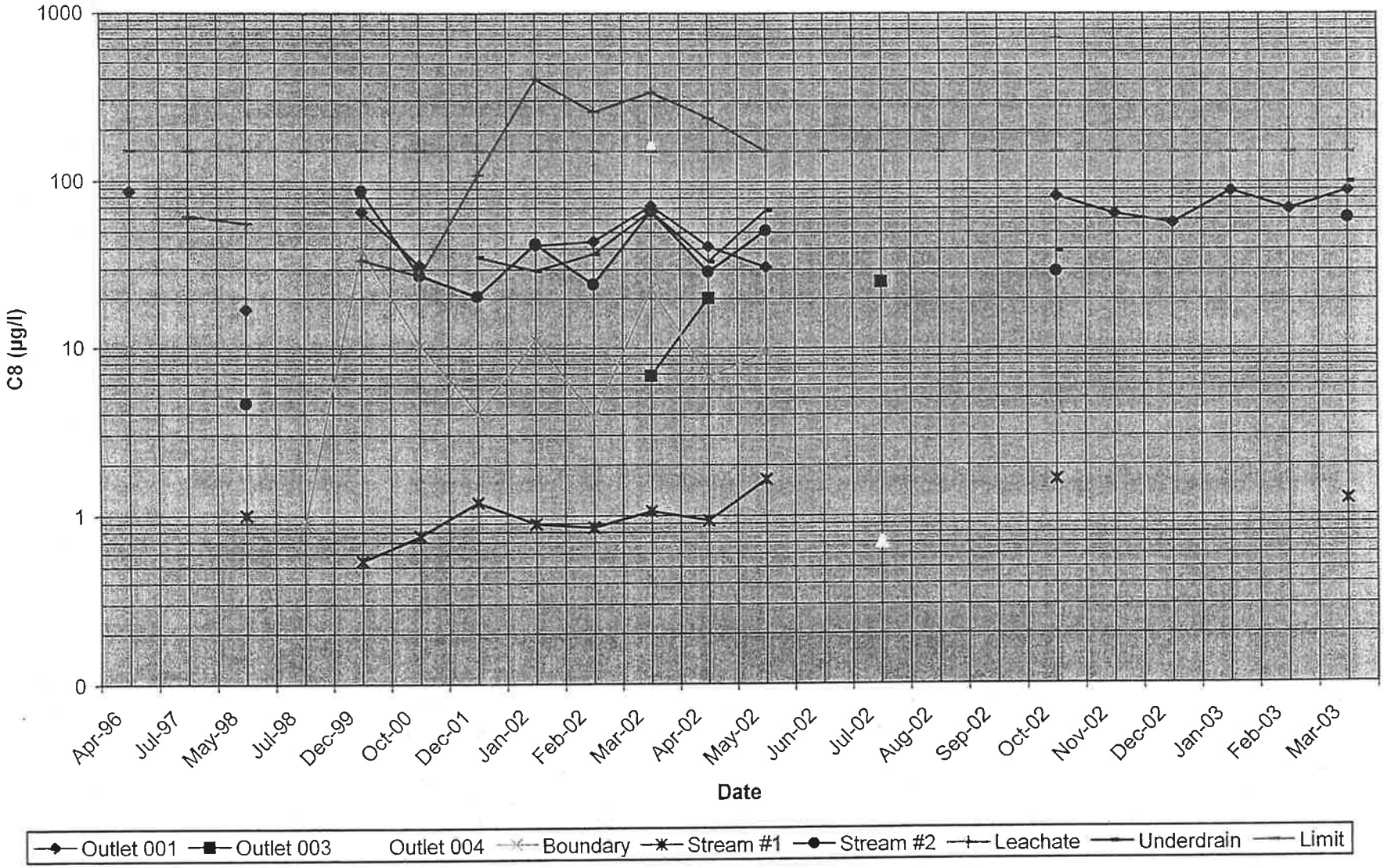
EPA 01079

APPENDIX B:

Groundwater data

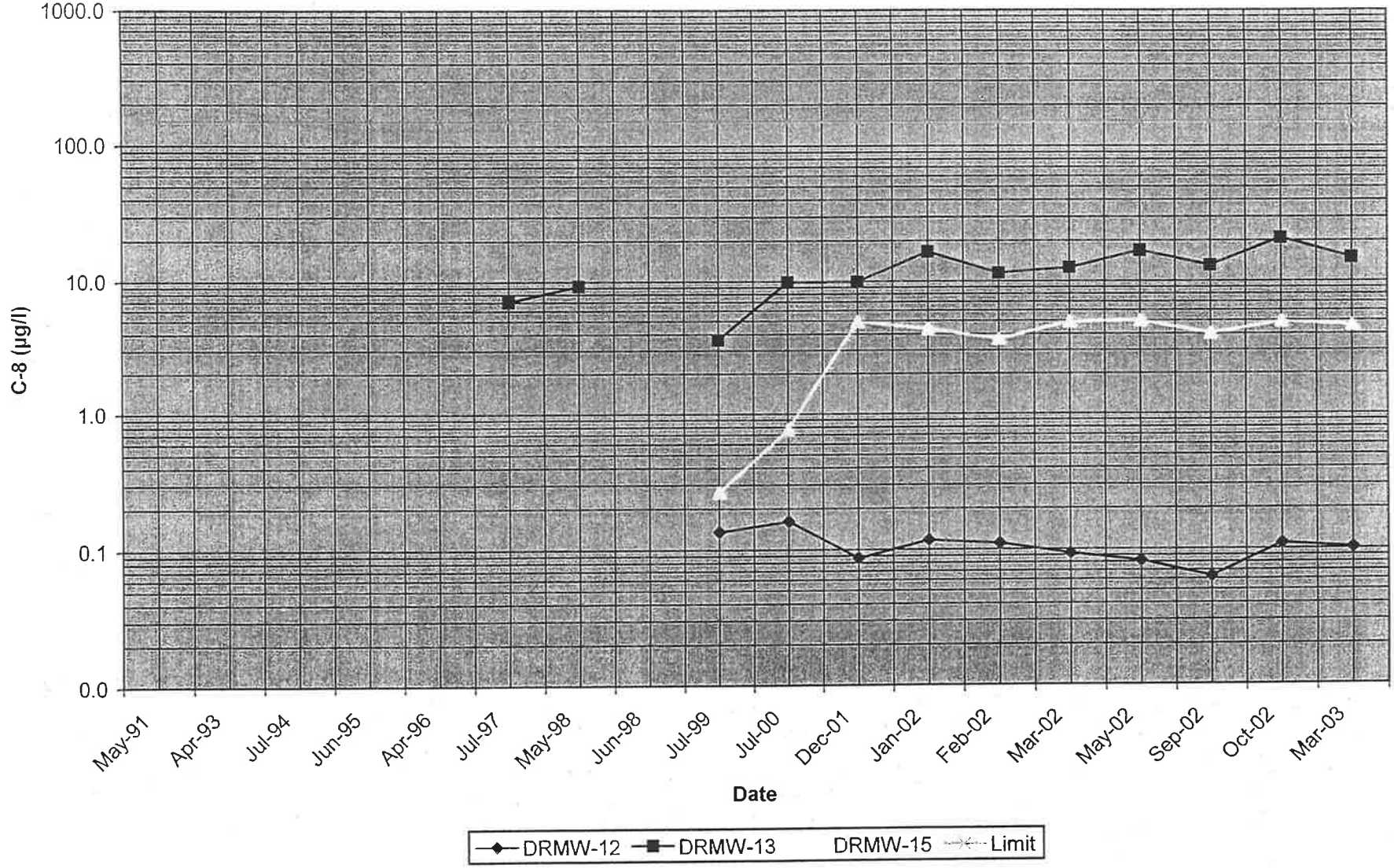
(both graphs and tables)

DRY RUN LANDFILL SURFACE WATER



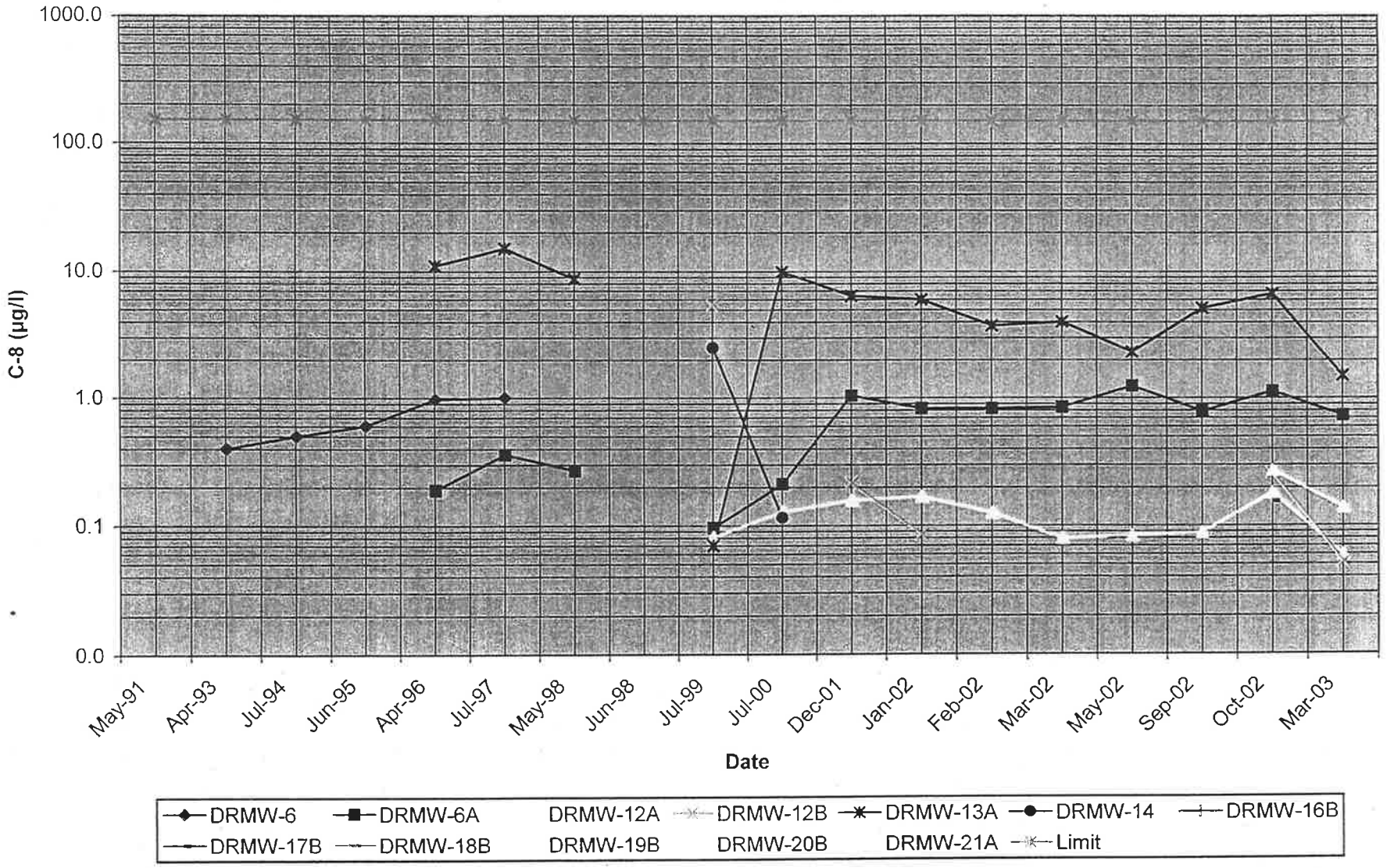
EPA 01081

DRY RUN LANDFILL ZONE A GROUNDWATER



EPA 01082

DRY RUN LANDFILL GROUNDWATER ZONE B



Du Pont de Nemours and Company
Dry Run Landfill
Wood County

C8 water data
Units are µg/l
A zero equals a Non Detect concentration
A yellow-colored concentration is above the WV-DEP limit
Groundwater monitoring well MW-21B is actually a "Zone C" well

Groundwater Zone A--

Date	*DRMW-12*	*DRMW-13*	*DRMW-15*	*Limit*
May-91				150
Apr-93				150
Jul-94				150
Jun-95				150
Apr-96	0			150
Jul-97	0	7		150
May-98	0	9.2		150
Jun-98				150
Jul-99	0.134	3.6	0.263	150
Jul-00	0.16	9.8	0.763	150
Dec-01	0.086	9.86	4.94	150
Jan-02	0.116	16.5	4.35	150
Feb-02	0.11	11.5	3.65	150
Mar-02	0.0929	12.6	4.91	150
May-02	0.0817	16.9	5	150
Sep-02	0.0626	13.1	3.99	150
Oct-02	0.109	20.9	4.92	150
Mar-03	0.101	15	4.64	150

Groundwater Zone B--

Date	*DRMW-6*	*DRMW-6A*	*DRMW-12A*	*DRMW-12B*	*DRMW-13A*	*DRMW-14*	*DRMW-16B*
May-91	0						
Apr-93	0.4						
Jul-94	0.5						
Jun-95	0.6						
Apr-96	0.97	0.19	0		11	0	
Jul-97	1	0.36	0		15	0	
May-98		0.27	0		8.7		
Jun-98				0		0	
Jul-99		0.096	0.081	5.4	0.07	2.5	
Jul-00		0.212	0.128	0	9.9	0.115	
Dec-01		1.04	0.158	0.215	6.4	0	
Jan-02		0.824	0.168	0.085	5.97	0	
Feb-02		0.822	0.125	0	3.73	0	
Mar-02		0.843	0.0785	0	4	0	
May-02		1.24	0.0832	0	2.31	0	
Sep-02		0.785	0.088	0	5.14	0	
Oct-02		1.13	0.181	0.258	6.66	0	0
Mar-03		0.727	0.059	0.052	1.5	0	0

Date	*DRMW-17B*	*DRMW-18B*	*DRMW-19B*	*DRMW-20B*	*DRMW-21A*	*Limit*
May-91						150
Apr-93						150
Jul-94						150
Jun-95						150

Apr-96						150
Jul-97						150
May-98						150
Jun-98						150
Jul-99						150
Jul-00						150
Dec-01						150
Jan-02						150
Feb-02						150
Mar-02						150
May-02						150
Sep-02						150
Oct-02	0.155	0	0	0	0.27	150
Mar-03			0	0	0.138	150

Groundwater Zone C--

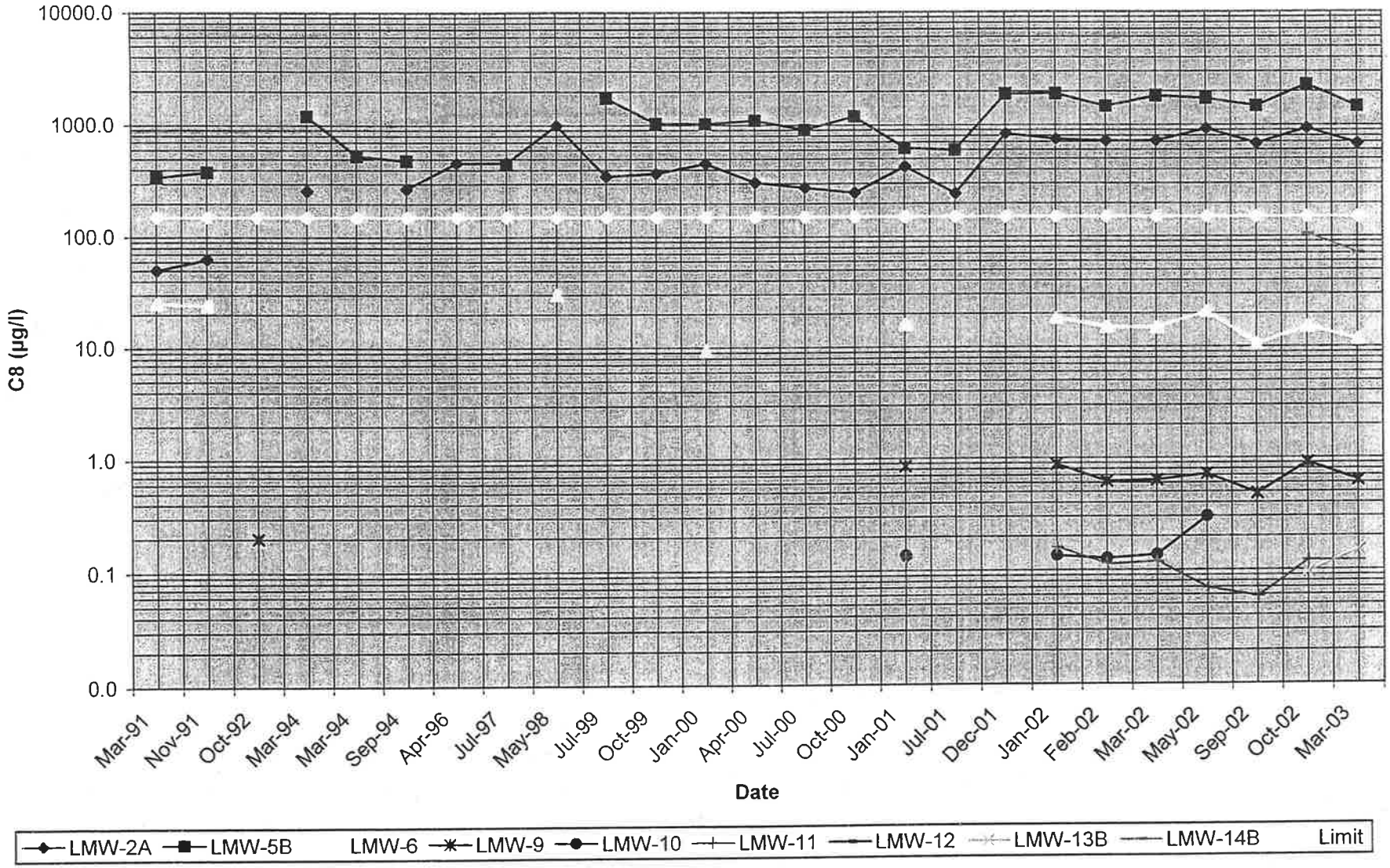
Date	*DRMW-21B*	*Limit*
May-91		150
Apr-93		150
Jul-94		150
Jun-95		150
Apr-96		150
Jul-97		150
May-98		150
Jun-98		150
Jul-99		150
Jul-00		150
Dec-01		150
Jan-02		150
Feb-02		150
Mar-02		150
May-02		150
Sep-02		150
Oct-02	0	150
Mar-03	0	150

Surface Water--

Date	*Outlet 001*	*Outlet 003*	*Outlet 004*	*Property Boundary*	*Stream #1*	*Stream #2*	*Dry Run Leachate*	*Pond Underdrain*	*Limit*
Apr-96	86			9.9					150
Jul-97							62		150
May-98	17				1	4.6	56		150
Jul-98				0.88					150
Dec-99	66			39	0.54	87	34		150
Oct-00	31.5			10.3	0.758	27.6	27.4		150
Dec-01				3.99	1.19	20.5	109	35.4	150
Jan-02	41.6			11.1	0.893	42.4	398	29.3	150
Feb-02	43.9			3.81	0.85	24.3	256	37.1	150
Mar-02	71.6	6.77	158	22.8	1.06	66.6	334	66.7	150
Apr-02	41	20.1		6.69	0.932	28.9	237	33.4	150
May-02	30.9			9.41	1.63	51	150	67.4	150
Jun-02									150
Jul-02		25.3	0.7						150
Aug-02									150
Sep-02									150
Oct-02	81.7			3.8	1.63	29.2	704	38.8	150
Nov-02	64.6								150
Dec-02	56.9								150

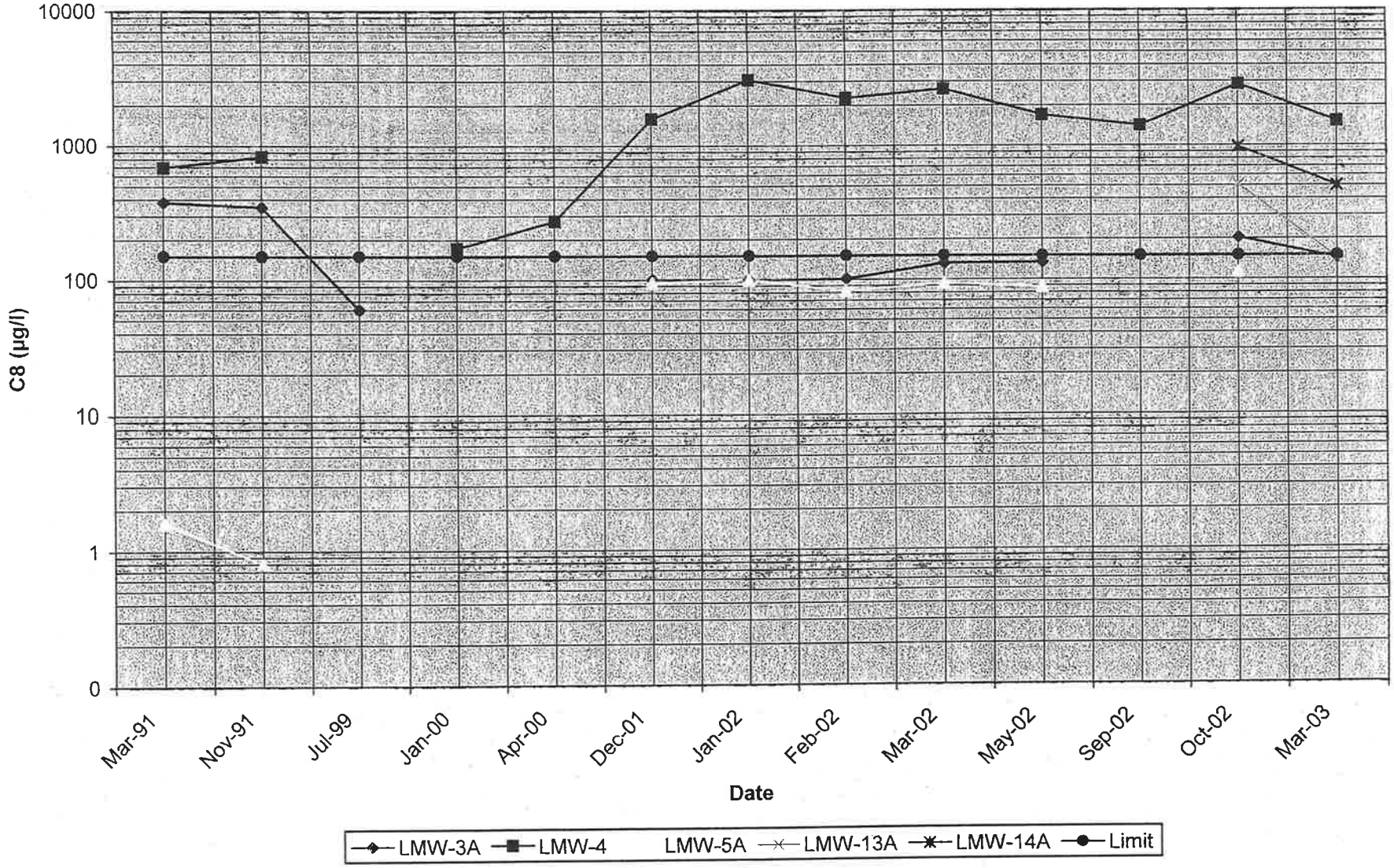
Date	Outlet 001	Outlet 003	Outlet 004	Boundary	Stream #1	Stream #2	Leachate	Underdrain	Limit
Jan-03	88.4								150
Feb-03	69								150
Mar-03	88.5			11.3	1.24	61.1	99.7	99.7	150

LeTART LANDFILL GROUNDWATER ZONE F



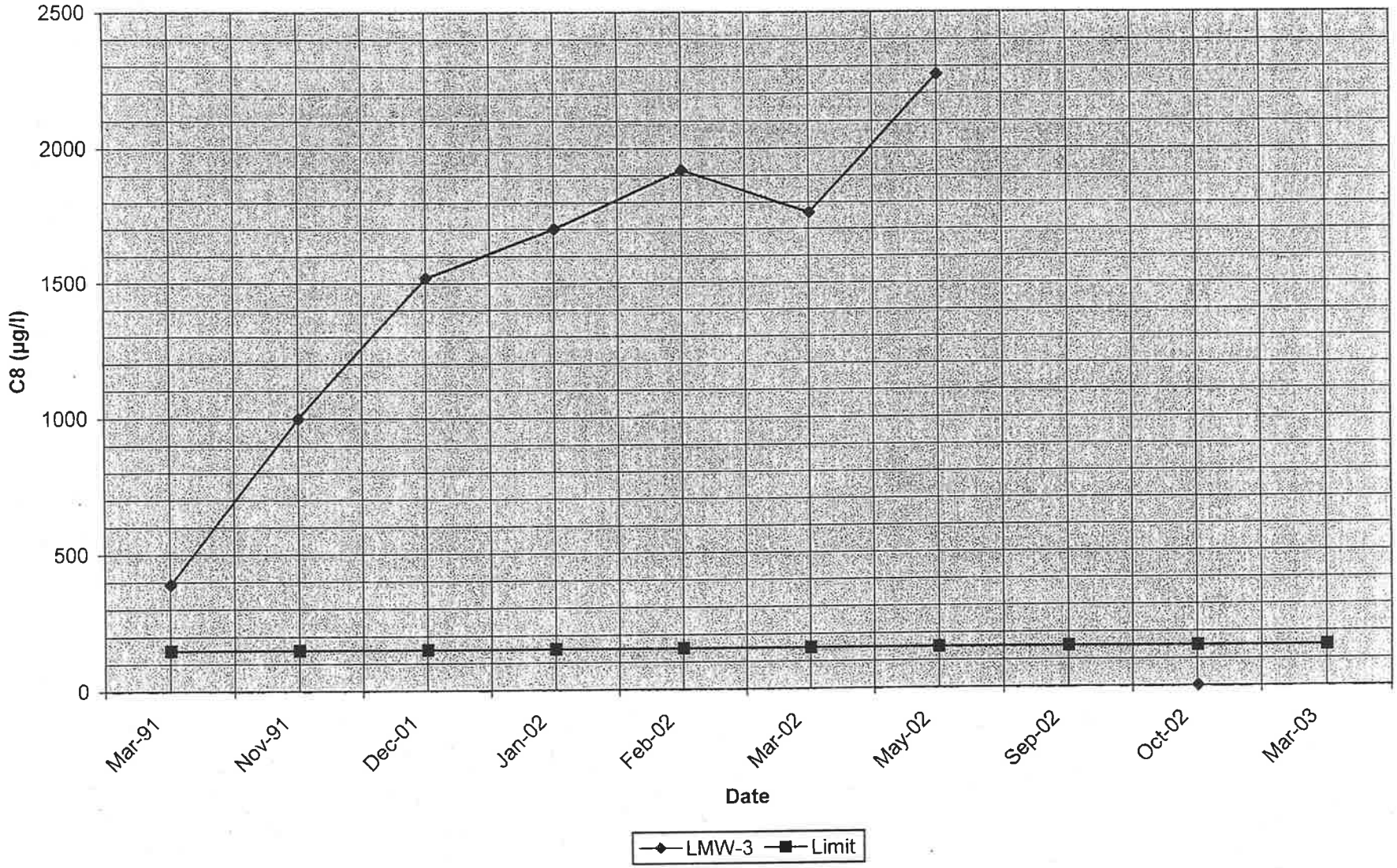
EPA 01087

LeTART LANDFILL GROUNDWATER ZONE D-E

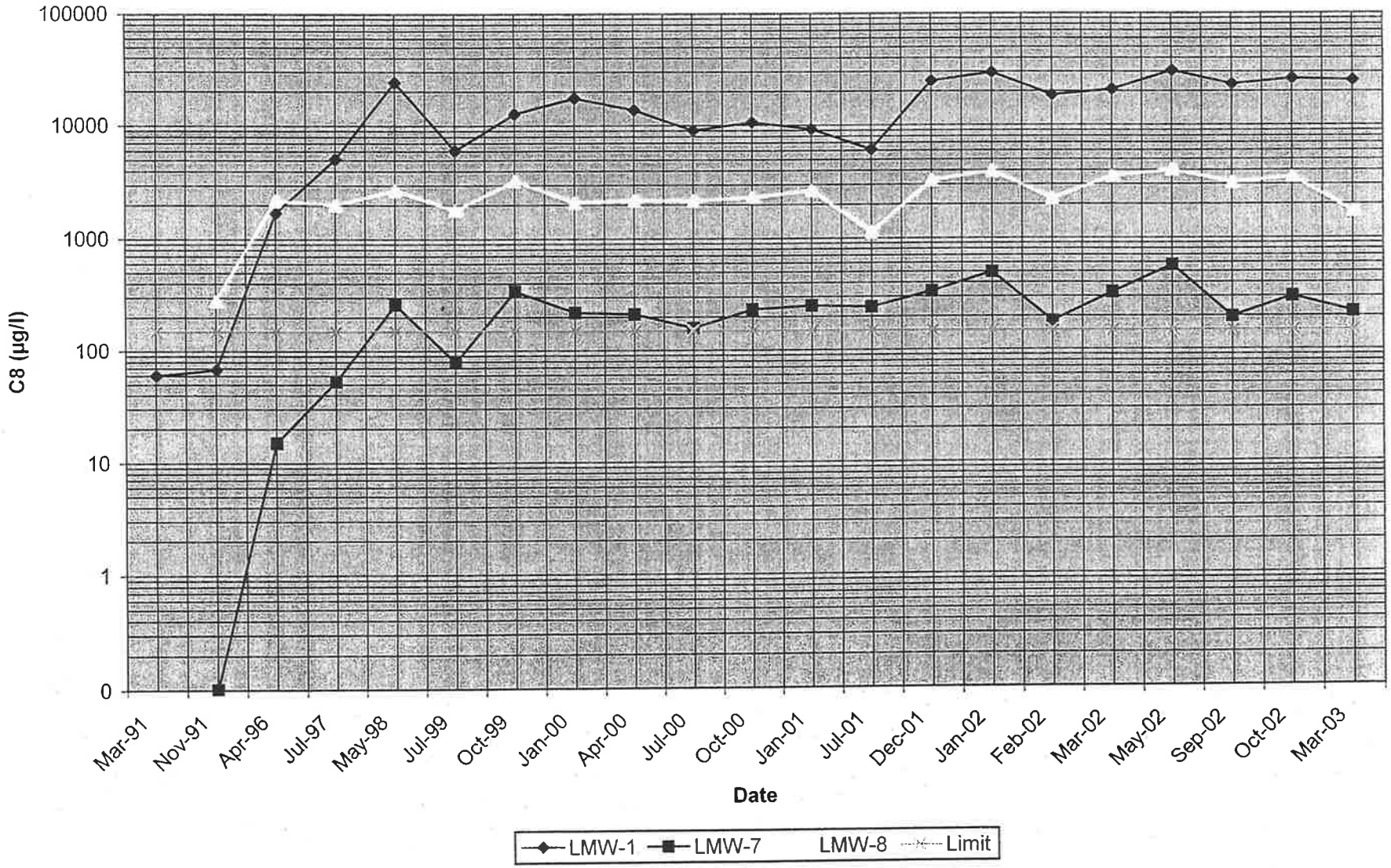


EPA 01088

LeTART GROUNDWATER ZONE C

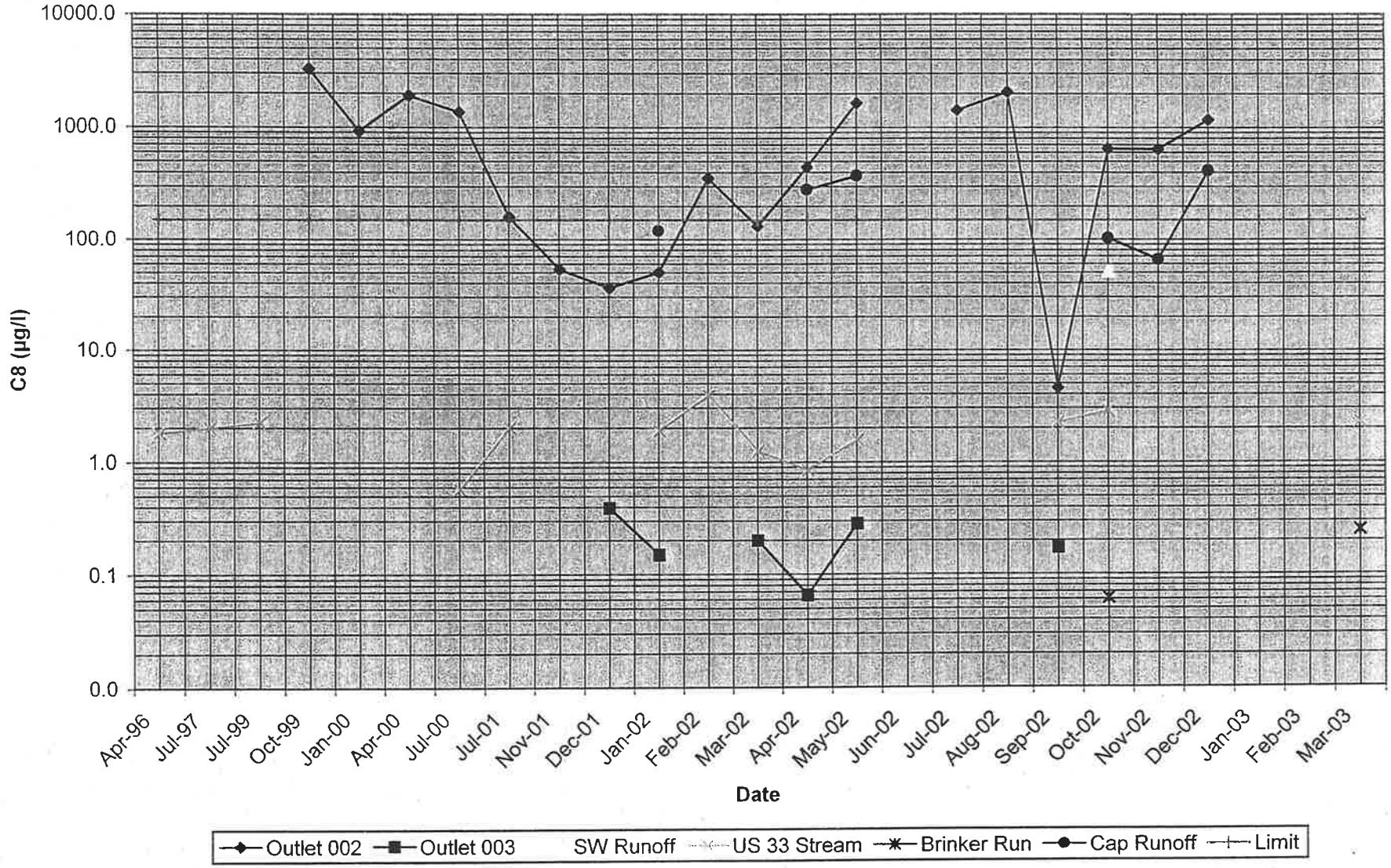


LeTART LANDFILL GROUNDWATER ZONE A



EPA 01090

LeTART LANDFILL SURFACE WATER



EPA 01091

Du Pont de Nemours and Company
LeTart Landfill
Mason County

C8 water data
Units are µg/l
A zero equals a Non Detect concentration
A yellow-colored concentration is a concentration above the WV-DEP's level

Groundwater data--
F-Zone wells--

Date	*LMW-2A*	*MW-5B*	*LWM-6*	*LMW-9*	*LWM-10*	*LWM-11*	*LMW-12*	*LMW-13B*	*LMW-14B*	*Limit*
Mar-91	50	340	25							150
Nov-91	63	380	24							150
Oct-92				0.2						150
Mar-94	260	1200								150
Mar-94		530								150
Sep-94	270	480								150
Apr-96	460									150
Jul-97	460	445								150
May-98	990		30							150
Jul-99	350	1750								150
Oct-99	370	1030								150
Jan-00	453	1020	9.4							150
Apr-00	306	1100								150
Jul-00	275	900								150
Oct-00	248	1190								150
Jan-01	423	615	15.8	0.845	0.134	0.128				150
Jul-01	242	592								150
Dec-01	830	1880								150
Jan-02	740	1890	18.1	0.875	0.133	0.159				150
Feb-02	714	1460	14.9	0.617	0.126	0.112				150
Mar-02	717	1810	14.8	0.631	0.136	0.119				150
May-02	922	1720	20.7	0.715	0.298	0.069				150
Sep-02	676	1480	10.5	0.479		0.058				150
Oct-02	931	2280	15.1	0.907		0.121		0.0956	105	150
Mar-03	676	1470	11.6	0.625		0.12		0.149	70.4	150

D-E Zone wells--

Date	*LMW-3A*	*LMW-4*	*LMW-5A*	*LMW-13A*	*LMW-14A*	*Limit*
Mar-91	380	690	1.6			150
Nov-91	350	830	0.8			150
Jul-99	60.3					150
Jan-00		172				150
Apr-00		272				150
Dec-01	100	1580	94.4			150
Jan-02	98.6	3060	99.3			150
Feb-02	101	2250	82.2			150
Mar-02	132	2620	93.6			150
May-02	134	1690	87.6			150
Sep-02		1410				150
Oct-02	204	2840	112	510	974	150
Mar-03	144	1520		144	498	150

C-Zone wells--

Date	*LMW-3*	*Limit*
Mar-91	390	150
Nov-91	1000	150
Dec-01	1520	150

Jan-02	1700	150
Feb-02	1920	150
Mar-02	1760	150
May-02	2270	150
Sep-02		150
Oct-02	0	150
Mar-03		150

A-Zone wells--

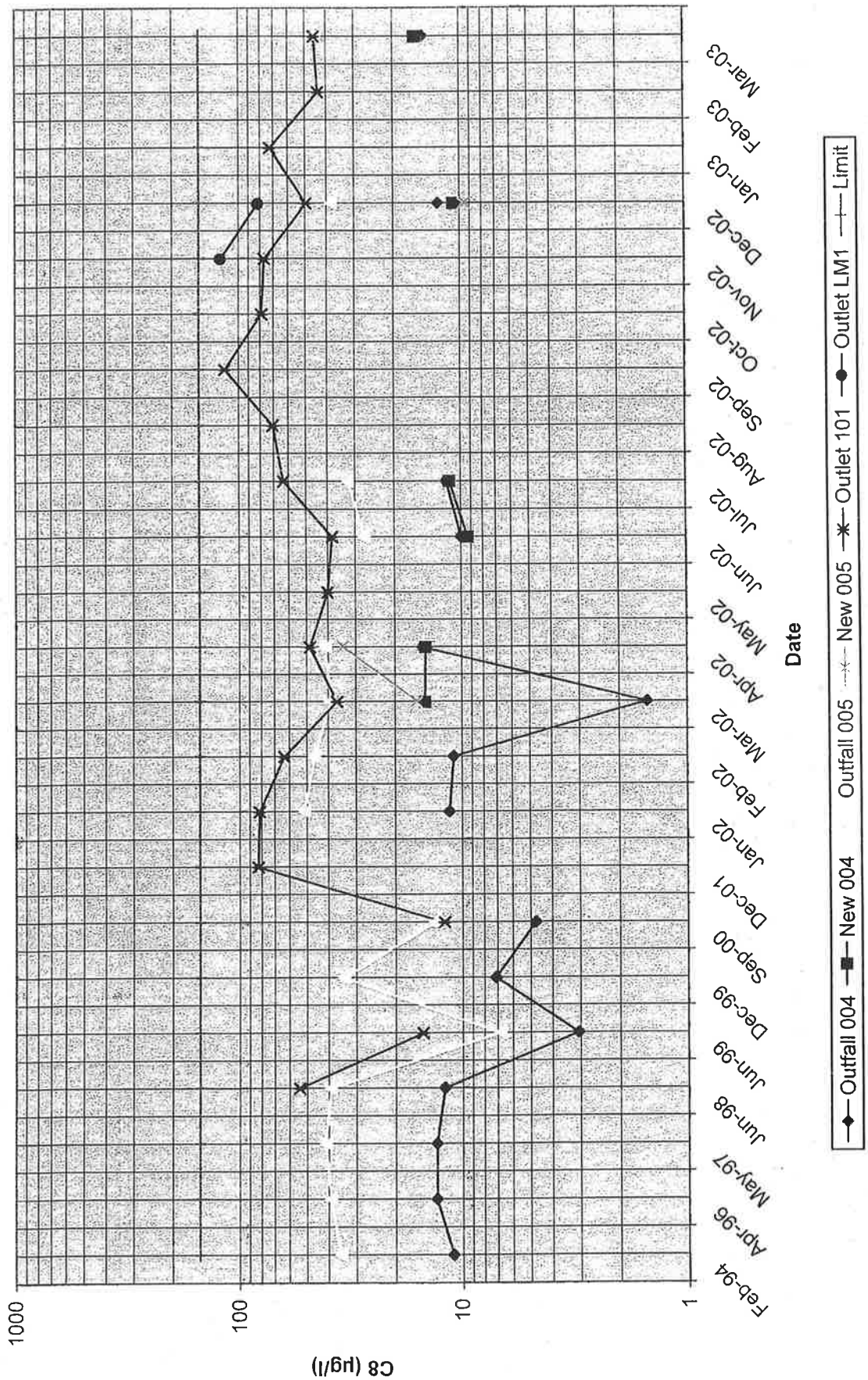
Date	*LMW-1*	*LMW-7*	*LMW-8*	*Limit*
Mar-91	60			150
Nov-91	68	0.1	280	150
Apr-96	1700	15	2200	150
Jul-97	5100	53	2000	150
May-98	24000	260	2700	150
Jul-99	6020	78.3	1790	150
Oct-99	12600	339	3260	150
Jan-00	17400	219	2100	150
Apr-00	13600	211	2180	150
Jul-00	8990	158	2160	150
Oct-00	10600	231	2300	150
Jan-01	9190	249	2650	150
Jul-01	6100	242	1120	150
Dec-01	24600	334	3240	150
Jan-02	29400	496	3930	150
Feb-02	18400	180	2230	150
Mar-02	20600	324	3520	150
May-02	30500	567	4020	150
Sep-02	23000	197	3100	150
Oct-02	25900	300	3480	150
Mar-03	25000	218	1720	150

Surface water--

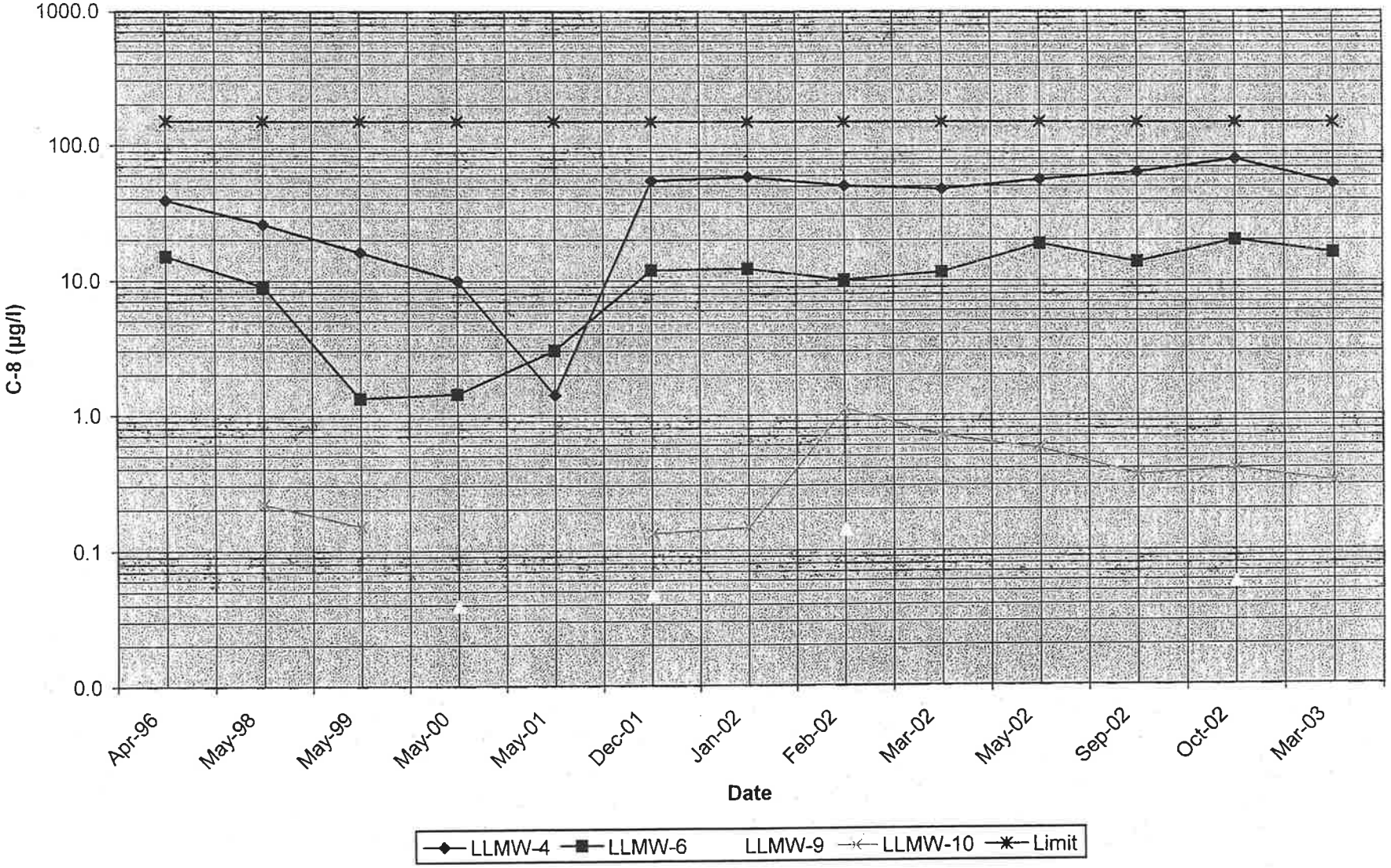
Date	*002*	*003*	*Stormwater Runoff*	*Route 33 Stream*	*Brinker Run*	*Cap Runoff*	*Limit*
Apr-96				1.8			150
Jul-97				2			150
Jul-99				2.23			150
Oct-99	3240						150
Jan-00	920						150
Apr-00	1900						150
Jul-00	1350			0.573			150
Jul-01	159			2.01			150
Nov-01	53.2						150
Dec-01	36.1	0.39					150
Jan-02	50.1	0.148		1.9		119	150
Feb-02	355			3.92			150
Mar-02	131	0.198		1.26			150
Apr-02	443	0.0653		0.845		279	150
May-02	1630	0.282		1.57		371	150
Jun-02							150
Jul-02	1410						150
Aug-02	2050						150
Sep-02	4.52	0.17		2.24			150
Oct-02	645		50.9	2.83	0.0612	102	150
Nov-02	639					65.1	150
Dec-02	1170					415	150
Jan-03							150
Feb-03							150
Mar-03				2.27	0.247		150

Date	002	003	SW Runoff 33 Stream	Brinker Run	Cap Runoff	Limit

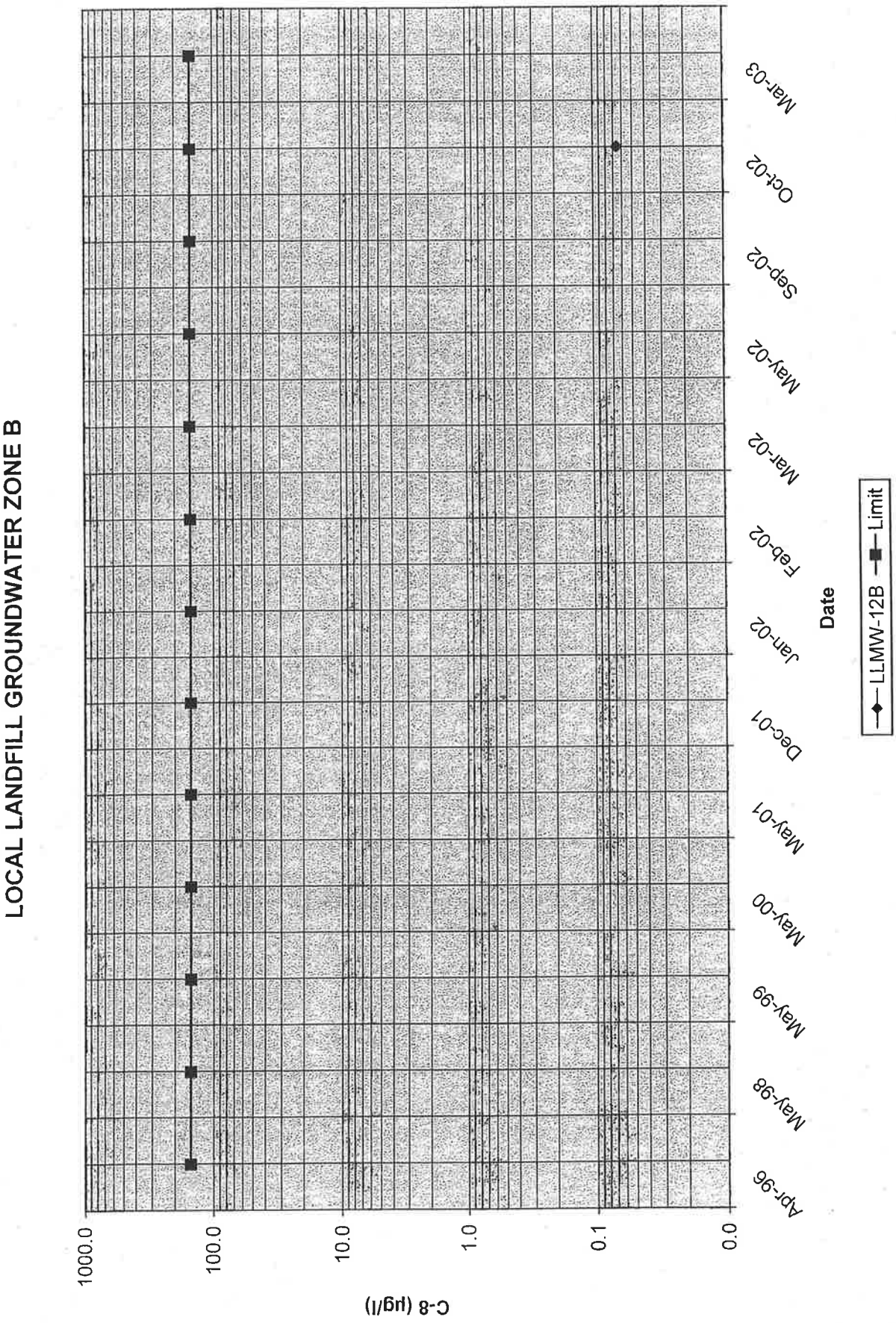
LOCAL LANDFILL SURFACE WATER



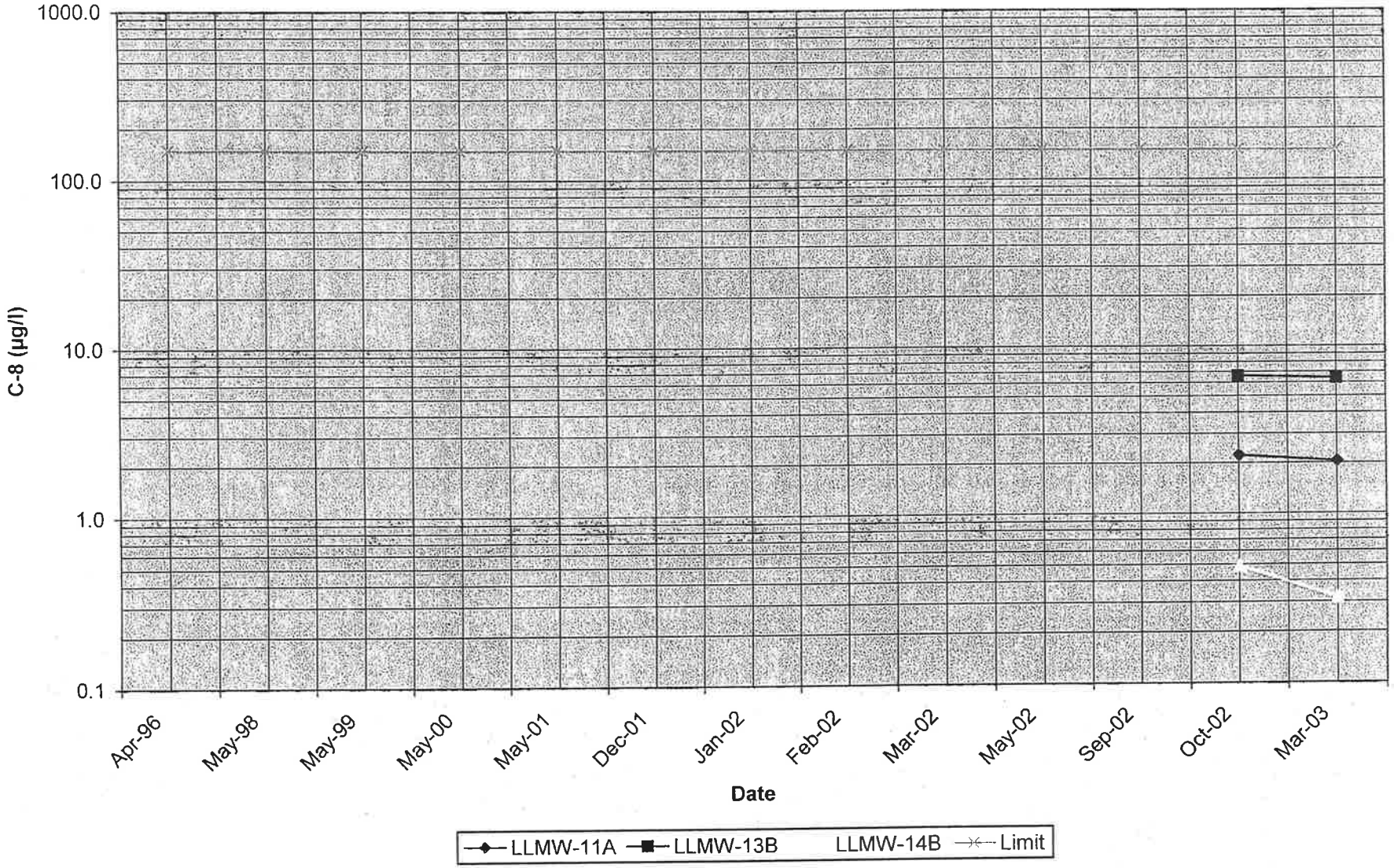
LOCAL LANDFILL GROUNDWATER ZONE A



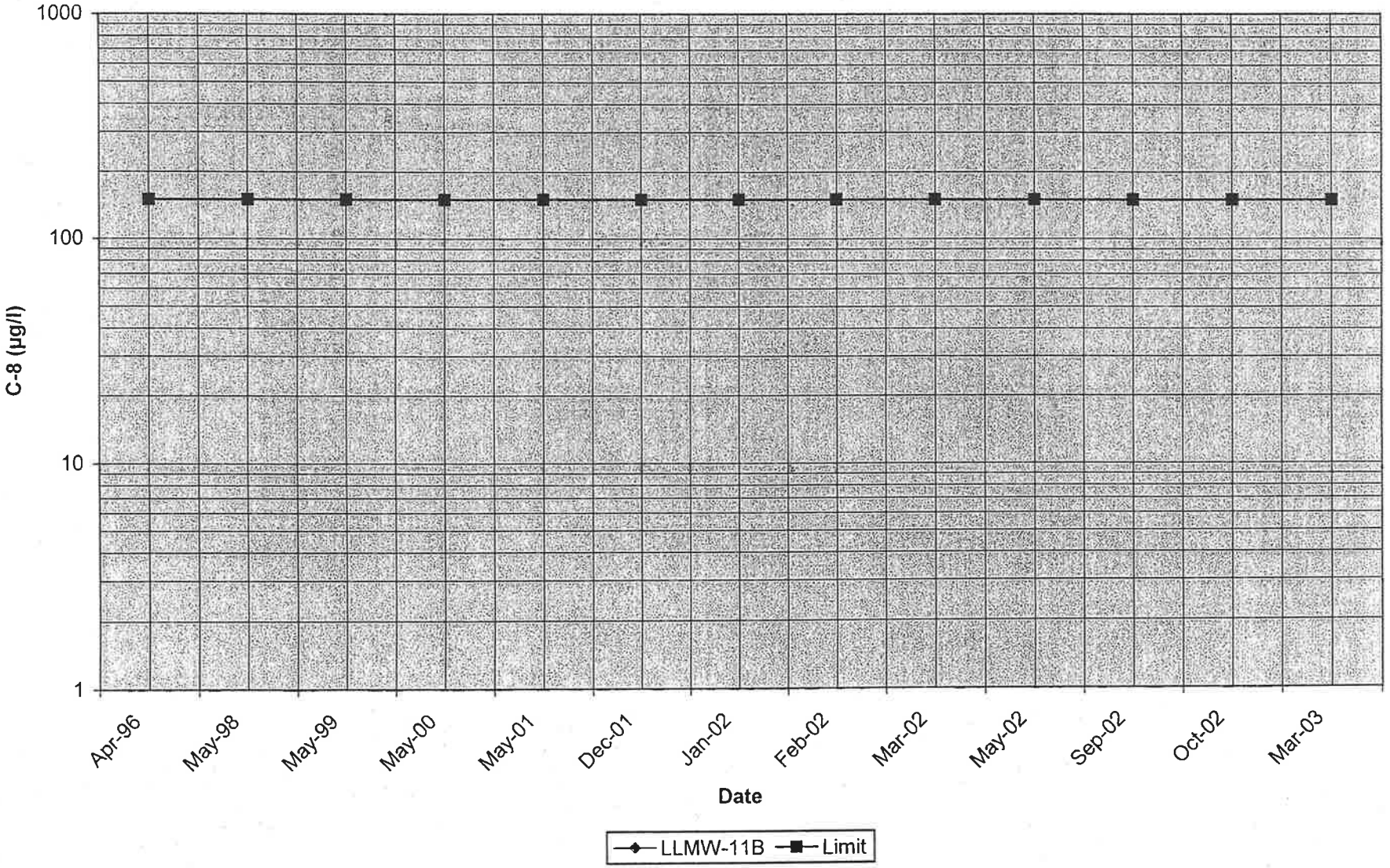
EPA 01096


LOCAL LANDFILL GROUNDWATER ZONE B
C-8 (µg/l)
1000.0
100.0
10.0
1.0
0.1
0.0
Apr-96
May-98
May-99
May-00
May-01
Dec-01
Jan-02
Feb-02
Mar-02
May-02
Sep-02
Oct-02
Mar-03
Date
LLMW-12B
Limit

LOCAL LANDFILL GROUNDWATER ZONE C



LOCAL LANDFILL GROUNDWATER ZONE D



EPA 01099

Du Pont de Nemours and Company
Local Landfill
Wood County

C8 water data
Units are µg/l
A zero equals a Non Detect concentration
A yellow-colored concentration is a concentration above the WV-DEP limit

Groundwater Zone A--

Date	*LLMW-4*	*LLMW-6*	*LLWM-9*	*LLMW-10*	*Limit*
Apr-96	39	15	0		150
May-98	26	9	0	0.22	150
May-99	16.2	1.32	0	0.15	150
May-00	10	1.42	0.039		150
May-01	1.4	3	0		150
Dec-01	54.6	11.9	0.046	0.133	150
Jan-02	58.4	12.2	0	0.146	150
Feb-02	50.2	10.1	0.14	1.12	150
Mar-02	47.2	11.5	0	0.698	150
May-02	55.7	18.6	0	0.56	150
Sep-02	63.5	13.7	0	0.357	150
Oct-02	79.6	19.9	0.0569	0.395	150
Mar-03	52.4	16.1	0	0.318	150

Groundwater Zone B--

Date	*LLMW-12B*	*Limit*
Apr-96		150
May-98		150
May-99		150
May-00		150
May-01		150
Dec-01		150
Jan-02		150
Feb-02		150
Mar-02		150
May-02		150
Sep-02		150
Oct-02	0.0658	150
Mar-03	0	150

Groundwater Zone C--

Date	*LLMW-11A*	*LLMW-13B*	*LLMW-14B*	*Limit*
Apr-96				150
May-98				150
May-99				150
May-00				150
May-01				150
Dec-01				150
Jan-02				150
Feb-02				150
Mar-02				150
May-02				150
Sep-02				150
Oct-02	2.22	6.61	0.488	150
Mar-03	2.05	6.38	0.317	150

Groundwater Zone D--

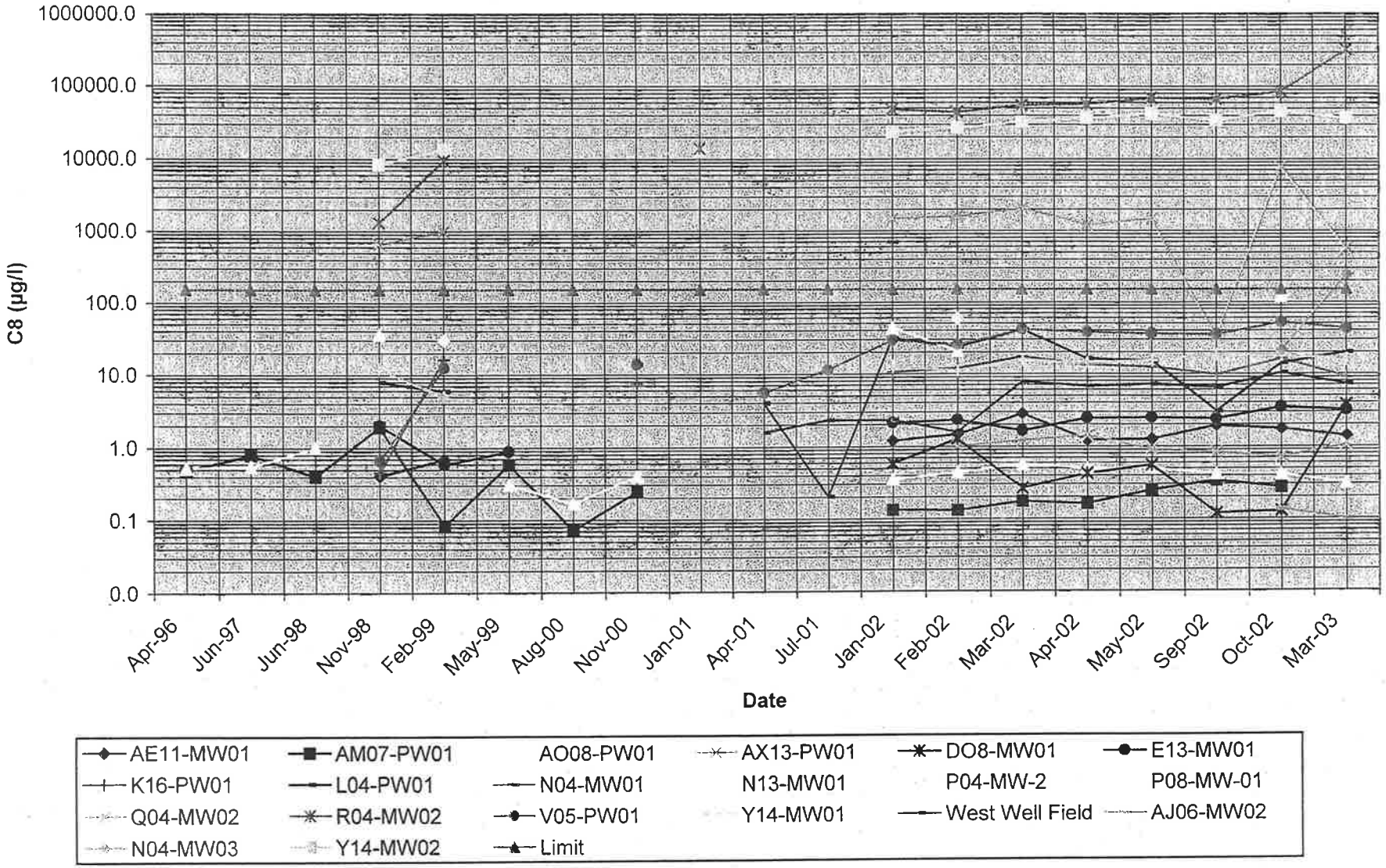
Date	LLMW-11B	Limit
Apr-96		150
May-98		150
May-99		150
May-00		150
May-01		150
Dec-01		150
Jan-02		150
Feb-02		150
Mar-02		150
May-02		150
Sep-02		150
Oct-02	0	150
Mar-03	0	150

Surface Water--

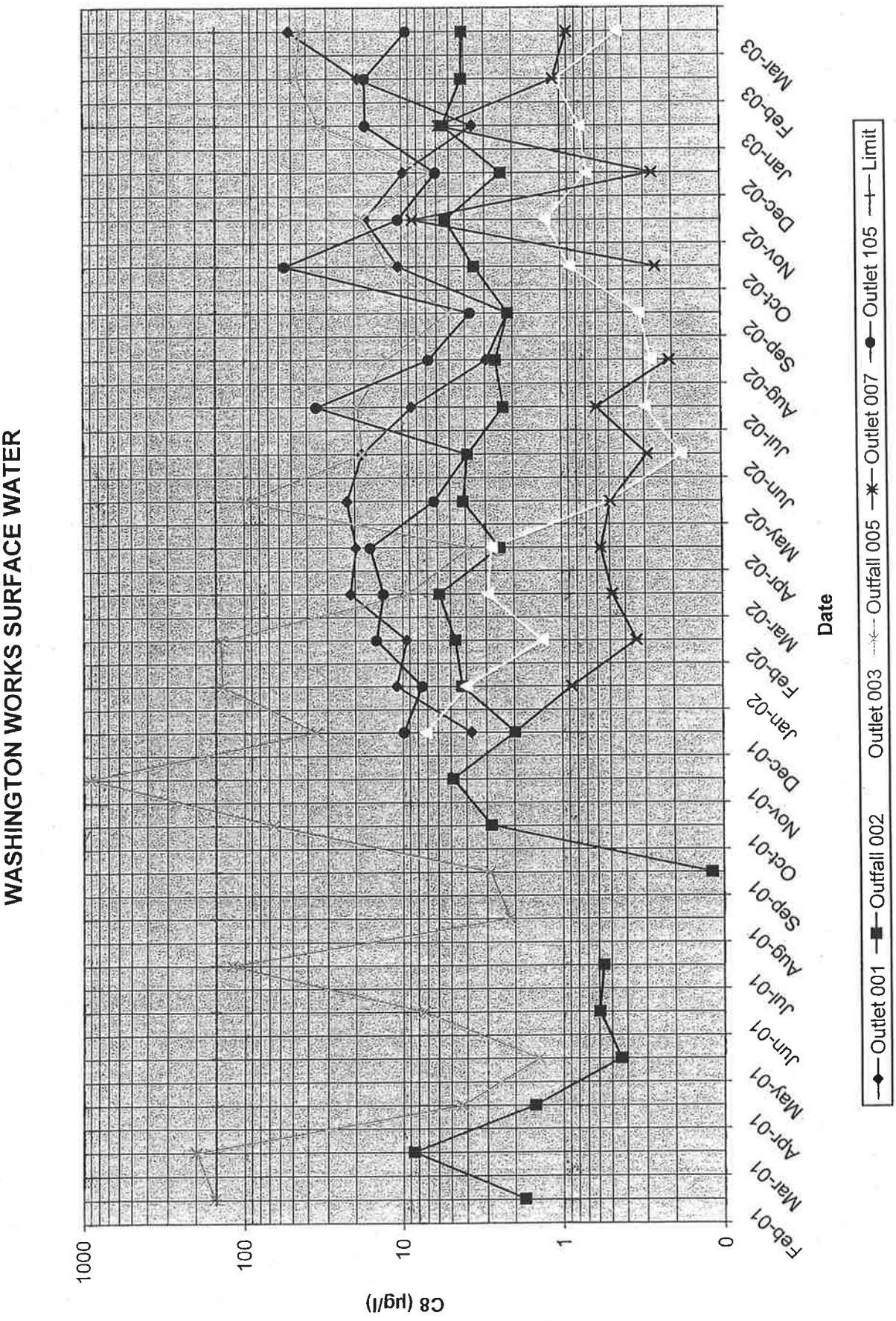
Date	Outfall 004	New 004	Outfall 005	New 005	Outlet 101	Outlet LM1	Limit
Feb-94	11		35				150
Apr-96	13		39				150
May-97	13		41				150
Jun-98	12		39		54		150
Jun-99	3.06		6.8		15		150
Dec-99	7.1		34				150
Sep-00	4.73		13.3		12		150
Dec-01					82.4		150
Jan-02	11.4		51.4		81.4		150
Feb-02	10.9		46		63.1		150
Mar-02	1.51	14.6	39	16	36.4		150
Apr-02	15	14.5	40.9	34.3	48.2		150
May-02					40		150
Jun-02	10	9.29	27.3		38		150
Jul-02	11.6	11.2	32.1		63		150
Aug-02					70.3		150
Sep-02					115		150
Oct-02					78.6		150
Nov-02					76.7	120	150
Dec-02	12.5	10.7	38.1	9.51	49.5	81.7	150
Jan-03					72.3		150
Feb-03					43.6		150
Mar-03	14.7	15.9	44.9		45.4		150

| Date | Outfall 004 | New 004 | Outfall 005 | New 005 | Outlet 101 | Outlet LM1 | Limit |

WASHINGTON WORKS GROUNDWATER



EPA 01102


WASHINGTON WORKS SURFACE WATER
C8 (µg/l)
1000
100
10
1
0
Feb-01
Mar-01
Apr-01
May-01
Jun-01
Jul-01
Aug-01
Sep-01
Oct-01
Nov-01
Dec-01
Jan-02
Feb-02
Mar-02
Apr-02
May-02
Jun-02
Jul-02
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Date
Outlet 001
Outfall 002
Outlet 003
Outfall 005
Outlet 007
Outlet 105
Limit

Du Pont de Nemours and Company
Washington Works
Wood County

C8 water data
Units are µg/l
A zero equals a Non Detect concentration
A yellow-colored concentration is a concentration above the WV-DEP limit

Groundwater--

Date	*AE11-MW01*	*AM07-PW01*	*AO08-PW01*	*AX13-PW01*	*DO8-MW01*	*E13-MW01*	*K16-PW01*	*L04-PW01*	*N04-MW01*
Apr-96		0.48	0.52						
Jun-97		0.79	0.55						
Jun-98		0.4	1						
Nov-98	0.41	1.9				2	0.46	7.9	
Feb-99	0.69	0.082				0.59	16.2	5.89	
May-99		0.578	0.307			0.882			
Aug-00		0.071	0.167						
Nov-00		0.24	0.4				7.5	13.8	
Jan-01									
Apr-01								3.99	
Jul-01								0.202	
Jan-02	1.2	0.131	0.355		0.582	2.11	10.5	30.9	689
Feb-02	1.45	0.129	0.439	1.03	1.27	2.32	12	23.5	
Mar-02	2.82	0.171	0.568	1.22	0.262	1.62	17.2	40.9	
Apr-02	1.22	0.159	0.497	1.42	0.424	2.44	13.2	16.1	
May-02	1.25	0.247	0.499	0.911	0.551	2.47	12.4	15.1	
Sep-02	1.92	0.335	0.42	0.834	0.117	2.39	9.71	3.06	
Oct-02	1.74	0.269	0.415	0.721	0.126	3.43	16.2	14.03	
Mar-03	1.37	0	0.308	1.07	3.72	3.15	8.93	19.8	

Date	*N13-MW01*	*P04-MW-2*	*P08-MW-01*	*Q04-MW02*	*R04-MW02*	*V05-PW01*	*Y14-MW01*	*West Well Field*
Apr-96								
Jun-97								
Jun-98								
Nov-98	0	8300	36	660	1300	0.66	12	
Feb-99	29.6	13600		994	9420	12.4	4.95	
May-99								
Aug-00								
Nov-00						13.7		
Jan-01		12600			13800			
Apr-01						5.48		1.58
Jul-01						11.4		2.31
Jan-02		23600	43.4	1480	47500	29	12.7	2.31
Feb-02	57.8	26800	20.7	1590	43600	25.1	10.9	1.58
Mar-02		32300		2070	54400	40.9	15.5	7.72
Apr-02		36500		1210	56300	37.6	13.9	6.69
May-02		42400		1480	68100	35.8	15.3	7.09
Sep-02		34400		32.2	66500	34.8	18.4	6.41
Oct-02		46600	120	7720	84100	51.2	18.2	10.3
Mar-03		36900		566	322000	42.5	15.7	7.2

Date	*AJ06-MW-02*	*N04-MW03*	*Y14-MW-02*	*Limit*
Apr-96				150
Jun-97				150
Jun-98				150
Nov-98				150
Feb-99				150
May-99				150
Aug-00				150
Nov-00				150

Jan-01				150
Apr-01				150
Jul-01				150
Jan-02				150
Feb-02				150
Mar-02				150
Apr-02				150
May-02				150
Sep-02				150
Oct-02	0.133	21.2	0	150
Mar-03	0.099	244	0	150

Surface water--

Date	*Outlet 001*	*Outfall 002*	*Outlet 003*	*Outfall 005*	*Outlet 007*	*Outlet 105*	*Limit*
Feb-01		1.74		153			150
Mar-01		8.54		199			150
Apr-01		1.5		4.31			150
May-01		0.436		1.43			150
Jun-01		0.594		7.4			150
Jul-01		0.558		120			150
Aug-01				2.16			150
Sep-01		0.118		2.86			150
Oct-01		2.8		65.7			150
Nov-01		4.84		915			150
Dec-01	3.72	1.98	7.13	35.2	1.99	9.78	150
Jan-02	10.9	4.23	3.99	137	0.871	7.53	150
Feb-02	9.43	4.66	1.33	141	0.339	14.6	150
Mar-02	21.4	5.85	2.91	9.26	0.483	13.2	150
Apr-02	19.7	2.45	2.76	3.8	0.567	15.9	150
May-02	22.4	4.13	0.503	98.6	0.49	6.27	150
Jun-02	17.9	3.86	0.175	17.9	0.284	3.86	150
Jul-02	8.63	2.29	0.291	19.2	0.597	34.7	150
Aug-02	2.94	2.56	0.268	12.4	0.207	6.73	150
Sep-02	2.15	2.14	0.317	5.02	0	3.69	150
Oct-02	10.5	3.49	0.87	12.1	0.251	54.9	150
Nov-02	17	5.28	1.24	18.1	8.56	10.5	150
Dec-02	9.75	2.37	0.68	6.62	0.263	6.07	150
Jan-03	3.58	5.46	0.75	33.4	5.77	16.9	150
Feb-03	18.9	4.15	1.06	46.4	1.1	17	150
Mar-03	51.4	4.11	0.43	43.1	0.897	9.25	150
Date	*Outlet 001*	*Outfall 002*	*Outlet 003*	*Outfall 005*	*Outlet 007*	*Outlet 105*	*Limit*

APPENDIX C:

Consent Order

No. GW-2001-019

CONSENT ORDER ISSUED PURSUANT TO ARTICLES 5 and 12, CHAPTER 22 AND ARTICLE 1, CHAPTER 16 OF THE WEST VIRGINIA CODE.

TO: E. I. DU PONT DE NEMOURS AND COMPANY DATE: November 14, 2001

West Virginia Department of Environmental Protection **Order No. GWR-2001-019**
West Virginia Department of Health and Human Resources

This **CONSENT ORDER** is issued by the Director of the Division of Water Resources and Director of the Division of Air Quality, West Virginia Department of Environmental Protection, and the Commissioner of the Bureau for Public Health, West Virginia Department of Health and Human Resources, pursuant to the authority set forth in more detail below.

I. INTRODUCTION OF PARTIES.

This Consent Order is entered into by and between the West Virginia Department of Environmental Protection [WVDEP], the West Virginia Department of Health and Human Resources – Bureau for Public Health [WVDHHR-BPH], and E. I. du Pont de Nemours and Company [DuPont][collectively referred to as the "Parties"].

II. PURPOSE OF CONSENT ORDER.

This Consent Order sets forth a series of tasks to be performed by the Parties in order to determine whether there has been any impact on human health and the environment as a result of releases of ammonium perfluorooctanoate [C8], CAS Number 3825-26-1, to the environment from DuPont operations. C8 is a material used by DuPont in its fluoroproducts manufacturing process at its Washington Works facility located at Washington, Wood County, West Virginia. C8 is not identified as a hazardous substance, hazardous waste or otherwise specifically regulated under West Virginia or federal statute or regulation.

This Consent Order has been negotiated in good faith and the actions undertaken by DuPont pursuant to this Consent Order do not constitute an admission of any liability on its part. DuPont retains the right to controvert in any other proceedings, other than proceedings to implement or enforce this Consent Order, the validity of the findings of fact and conclusions of law set forth herein. DuPont agrees to comply with and be bound by the terms of this Consent Order and further agrees in any proceeding to implement or enforce this Consent Order that it

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will not contest the validity of this Consent Order or the jurisdiction of WVDEP and WVDHHR-BPH to issue it.

III. DEFINITIONS.

Whenever the terms identified below are used in the Consent Order or in any exhibit or attachment hereto, the following definitions shall apply:

1. "The Agencies" shall mean the Department of Health and Human Resources, Bureau for Public Health and the Department of Environmental Protection, including the Divisions of Air Quality and Water Resources.

2. "C8" shall mean the chemical compound ammonium perfluorooctanoate.

3. "Detection Limit" means the lowest analytical level that can be reliably achieved within specified limits of precision and accuracy under routine laboratory conditions for a specified matrix. It is based on quantitation, precision and accuracy under normal operation of a laboratory and the practical need in a compliance-monitoring program to have a sufficient number of laboratories available to conduct the analyses.

4. "Effective Date" shall mean the date set forth in Section XVII of this Consent Order.

5. "EPA" shall mean the United States Environmental Protection Agency.

6. "Force Majeure" shall mean conditions or circumstances beyond the reasonable control of DuPont which could not have been overcome by due diligence and shall include, without limitation, acts of God, action or inaction of governmental agencies, or administrative or judicial tribunals or other third parties, or strikes or labor disputes (provided, however, DuPont shall not be required to concede to any labor demands), which prevent or delay DuPont from complying with the work plan.

7. "Groundwater Monitoring Well" shall mean any cased excavation or opening into the ground made by digging, boring, drilling, driving, jetting, or other methods for the purpose of determining the physical, chemical, biological, or radiological properties of groundwater. The term "monitoring well" includes piezometers and observation wells, which are installed for purposes other than those listed above, but does not include wells whose primary purpose is to provide a supply of potable water.

8. "Groundwater Well" or "Well" shall mean any drilled or excavated groundwater collection system that supplies water for public, private, industrial, or agricultural use and shall include drinking water wells. As used in this Consent Order, this term applies only to wells

located in West Virginia.

9. "Reimbursable Costs" shall mean costs attributable (on an hourly basis) to the work of Dee Ann Staats, Ph.D. in the negotiation and implementation of this Consent Order, the costs attributable to any other participants on the C8 Assessment of Toxicity Team, as described in Attachment C to this Consent Order, who are serving in that position as contractors to WVDEP, costs incurred by WVDEP in connection with the public meetings described in Attachment C, and costs attributable to any contractor retained at the direction of the Groundwater Investigation Steering Team (GIST).

10. "Washington Works" shall mean the manufacturing facility owned by DuPont and located in Washington, Wood County, West Virginia, as depicted on Exhibit 1 to this Consent Order.

11. "The Facilities" shall mean the Washington Works and the Local Landfill, depicted on Exhibit 1, the Letart Landfill, depicted on Exhibit 2, and the Dry Run Landfill, depicted on Exhibit 3.

12. "Reference Dose" or "RfD" shall mean an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound.

13. "Screening Level" shall mean the concentration in a specific media such as air, water, or soil, that is likely to be without an appreciable risk of deleterious effects during a lifetime in the human population.

IV. WAIVER OF RIGHTS.

DuPont waives any and all rights it may have to appeal or challenge the validity or requirements of this Consent Order, and shall not challenge the jurisdiction of the Agencies to issue this Consent Order.

This Consent Order applies to and is binding upon the Parties, and their successors and assigns.

V. FINDINGS OF FACT.

1. C8 is a chemical substance which has no established state or federal effluent or emission standards.

2. C8 is a perfluorinated surfactant manufactured by the 3M Company and others.

Since the early 1950's C8 has been used by DuPont in its fluoropolymer-related manufacturing processes at its Washington Works facility, located in Wood County, West Virginia.

3. Residues containing C8 from fluoropolymer manufacturing processes at Washington Works are or have been released to the air, discharged to the Ohio River, disposed of at the Facilities, and otherwise shipped off-site for destruction and/or disposal. DuPont also captures for recycle a significant portion of used C8.

4. No permits issued to DuPont authorizing releases of pollutants to the environment contain specific limitations on the amount of C8 that may be released to the environment. However, C8 releases are addressed more generally in WVDEP Division of Air Quality permits as particulate matter, PM_{10} (particulate matter with an aerodynamic diameter less than or equal to 10 microns), or as a volatile organic compound.

5. Since as early as 1990, DuPont has performed regular, voluntary water sampling to detect the presence and level of C8 in and around certain of its Facilities in West Virginia and has reported the results of this sampling to various government agencies. Currently, DuPont also samples and reports C8 concentrations in water as required by permits issued by WVDEP and EPA.

6. As a result of DuPont's sampling, C8 has been detected in varying concentrations in and around certain of its Facilities in West Virginia, including private drinking water wells and public water supplies.

7. Analyses of water samples have reported levels of C8 in the Lubeck Public Service District ("LPSD") drinking water supply.

8. DuPont, by and through its use of C8 in the fluoropolymer manufacturing process, is the likely source of C8 presence in and around certain of its Facilities in West Virginia.

9. Along with environmental sampling for C8, DuPont has performed and participated in multiple studies examining the potential effects of C8 exposure on human health and the environment.

10. Studies performed by DuPont and 3M have determined that C8 in sufficient doses, i.e., considering both amount and duration of exposure, is toxic to animals through ingestion, inhalation and dermal contact. Studies have also found that C8 is persistent in humans and the environment.

11. Although DuPont has collected a large amount of data on the presence of C8 in the environment, the Agencies believe that additional information will assist them in delineating the extent and concentrations of C8 in the environment at or near the Facilities. Available data collected by DuPont indicates that C8 is present in the surface and groundwater at the Letart and

Dry Run Landfills and at or near the Washington Works facility.

12. WVDEP and WVDHHR-BPH have determined that it is desirable to ascertain the source of drinking water for persons potentially exposed to C8 in groundwater or surface waters in the area of the Facilities.

13. EPA, WVDEP, and WVDHHR-BPH, in consultation and cooperation with one another, have requested, and DuPont has submitted, information and documents relating to the detection and presence of C8 in and around the Facilities and documents with respect to the human health studies being performed related to C8 exposure.

14. Based upon information submitted by DuPont and reviewed to date by EPA, WVDEP, and WVDHHR-BPH, the Agencies believe that additional data would assist in their evaluation of whether the ground and surface waters now containing C8 have a complete exposure pathway to humans and whether persons in and around the Facilities are at risk of adverse health effects from C8 exposure.

15. There have been no independent governmental or non-industrial studies performed on the human health effects of C8 exposure for the purpose of establishing an exposure standard for C8 applicable to the general public.

16. The Agencies have concluded that full site and health assessments are necessary to ascertain the extent and level of C8 concentrations in the environment and to assist them in determining whether C8 presents any possible danger to the public. DuPont has agreed to participate and assist in this effort.

17. The fluoropolymers industry has committed to EPA to reduce total actual C8 emissions for either the year 1999 or the year 2000 by 50 percent within three to five years of each company's commitment date. DuPont committed to this goal in 2000.

18. DuPont installed, in March 2001, a filter and carbon treatment system at its Washington Works facility that is demonstrating removal efficiency of 90-95% of the C8 in its major C8-containing wastewater stream.

VI. AUTHORITY TO ISSUE CONSENT ORDER.

1. The WVDEP is the state agency vested with the authority to protect the environment in West Virginia.

2. Article 12, Chapter 22 of the West Virginia Code, the Groundwater Protection Act, grants to the WVDEP the authority to protect the State's groundwater from any contaminant

and, where contaminated groundwater is found, to institute a civil action or issue an order requiring that groundwater be remediated.

3. Article 5, Chapter 22 of the West Virginia Code, the Air Pollution Control Act, grants to the WVDEP the authority to protect the State's air from pollutants and to institute a civil action or issue orders to enforce the statute.

4. The WVDHHR-BPH is the state agency vested with the authority to regulate and protect drinking water supplies in West Virginia.

5. Article 1, Chapter 16 of the West Virginia Code, grants to the WVDHHR-BPH the authority to protect the public drinking water supply of the state and to perform all investigation necessary to assure its purity and safety, and further grants to the WVDHHR-BPH the authority to institute actions and issue orders to restore the purity of said water supply.

VII. REQUIREMENTS OF CONSENT ORDER.

The Agencies have concluded that it is of great importance to have sufficient data upon which to determine the scope and potential risk of the presence of C8 in the environment in and around the Facilities. Therefore, the Agencies require the following:

A. Establishment of Groundwater Investigation Steering Team.

1. A "Groundwater Investigation Steering Team" (GIST) shall be established with members of the team consisting of WVDEP, WVDHHR-BPH, EPA Region III, and DuPont. The WVDEP representative will be the team leader. The objectives and specific tasks of the team are set forth in full in Attachment A of this Consent Order. However, the primary purpose of the GIST will be to oversee an expeditious, phased approach to fulfilling the majority of the requirements set forth in Sections A through C. The work performed with oversight from the GIST shall be funded by DuPont in accordance with Section VIII of this Consent Order.

2. Upon conclusion of key milestones in the tasks set forth in Attachment A, the GIST shall issue interim or final reports setting forth findings of fact and conclusions regarding background data, groundwater monitoring, and plume identification as described in Attachment A. Any groundwater monitoring plan developed pursuant to Attachment A shall survive the termination of this Consent Order and shall be incorporated as a minor permit modification for the Facilities. DuPont reserves the right to request modification of the plans upon renewal of the Facilities' permits.

B. National Pollutant Discharge Elimination System Requirements.

1. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at the Local Landfill at certain outfalls identified in West Virginia/National Pollutant Discharge Elimination System ("WV NPDES") Permit No. 0076538 as Outfalls 101, 004 and 005.

2. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at the Washington Works facility at certain outfalls identified in WV NPDES Permit No. WV0001279 as Outfalls 001, 002, 003, 005, 007, and 105.

3. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at Dry Run Landfill at all outfalls identified in its WV NPDES Permit No. WV0076244.

4. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at Letart Landfill at all outfalls identified in its WV NPDES Permit No. WV0076066.

5. With respect to the requirements of paragraphs VII.B.1 through VII.B.4, all sampling shall be performed pursuant to established EPA guidelines, where applicable, and results shall be delivered to the WVDEP within thirty days of receiving such results. DuPont shall record and report all attempts to sample under no-flow conditions.

6. Within 90 days of the Effective Date of this Consent Order, DuPont agrees to obtain a sample from each surface or alluvial water intake for public water supplies along the Ohio River in the area extending ten river miles downstream of the Washington Works facility and one river mile upstream of the Washington Works facility. If concentrations of C8 above the Detection Limit are found in any sampled public water supply within the upstream or downstream segments initially sampled, the segments within which intakes are to be sampled shall be extended to twenty river miles downstream or two river miles upstream, as appropriate. If concentrations above the Detection Limit are found in any segment so extended, additional sampling will be performed on water intakes within thirty river miles downstream or three river miles upstream, as appropriate.

7. The additional monitoring requirements contained in this subsection shall be incorporated into the Facilities' West Virginia/National Pollutant Discharge Elimination System permits by minor modification. DuPont reserves the right to request a modification of these requirements upon renewal of the permits.

C. Toxicological and Human Health Assessment.

1. DuPont agrees to fund the various tasks set forth below as a part of this Consent Order by establishing an escrow account at a bank agreed to by the Parties, or by some other

means agreed to by the Parties. Disbursements from said escrow shall be authorized by the C8 Toxicity Team Leader and DuPont representative jointly as described below.

2. A C8 Assessment of Toxicity Team ("CAT Team") shall be established with members of the team consisting of representatives of:

WVDEP
WVDHHR-BPH
EPA Region III
NICS
ATSDR
DuPont

3. The WVDEP representative shall be the Team Leader.

4. The individual team members, the tasks of the team, and the team objectives are set forth in full in Attachment C of this Consent Order.

5. Upon conclusion of all the tasks set forth in Attachment C, the CAT Team shall issue a final report setting forth findings of fact and conclusions as to what extent there may be health risks associated with C8 at the Facilities.

D. Emission Modeling Assessment.

1. The following information shall be submitted to the Division of Air Quality ("DAQ") within 30 days of the Effective Date except where a different deadline is provided in this subsection:

a. A complete and accurate list of building dimension parameters for all structures located within the Washington Works facility that have a significant impact on the dispersion of C8 emissions. Significant impact for each structure on the site shall be determined based on the "area of building wake effects" as defined in the EPA User's Guide to the Building Profile Input Program (EPA-454/R-93-038 Revised Feb. 8, 1995).

b. A complete and accurate list of DuPont's current permitted allowable emission rates and confirmed actual C8 emission rates in pounds per year for the year 2000 for all sources located within the Washington Works facility. Each emission point shall be listed according to its stack I.D. and corresponding permit number. For each stack identified above as emitting C8 DuPont shall list all relevant stack parameters to be used in air dispersion modeling.

c. For each emission point (stack) emitting C8, the following information shall be supplied:

i. Phase of C8 (solid, vapor or aqueous solution) at stack conditions.

ii. The particle characterization to be used for modeling including the particle size distribution (microns), the mass fraction of C8 in each particle size category, and the particle density (g/cm^3).

iii. For particulate emissions, scavenging coefficients (hr/s-mm) for both liquid and frozen precipitation to be used for wet deposition modeling based upon the particle size distribution and the EPA's Industrial Source Complex, Version 3 Model Guidance (EPA-454/B-95-003b Sept. 1995) ("ISC Guidance"). DuPont may submit, within 30 days of the Effective Date, information to support the use of the normalized scavenging coefficient in the ISC Guidance (Figure 11 of ISC Guidance) for C8's scavenging coefficients. DAQ shall approve or disapprove with justification in writing, DuPont's submission. Should DAQ disapprove, DuPont shall have the right, within seven days, to request a meeting with DAQ and USEPA to address the deficiencies set forth in DAQ's letter and to request reconsideration of DAQ's decision. Following a meeting of the parties, DAQ shall issue a decision letter regarding C8's scavenging coefficients within seven days of the meeting. DAQ reserves the right to require measurement of C8's scavenging coefficients in its decision and DuPont reserves the right to assert a claim of confidentiality in the event such a measurement is made.

iv. For gaseous emissions, scavenging coefficients (hr/s-mm) for both liquid and frozen precipitation to be used for wet deposition modeling will be provided as a function of droplet size using formulae in the open literature based on the physical properties of C8 and consistent with Section 1.4 of the ISC Guidance. DuPont may submit, within 30 days of the Effective Date, information to support the proposed scavenging coefficient for gaseous emissions including information on the percentage of C8 emissions that would be in gaseous form. DAQ shall approve or disapprove with justification in writing, DuPont's submission. Should DAQ disapprove, DuPont shall have the right, within seven days, to request a meeting with DAQ and USEPA to address the deficiencies set forth in DAQ's letter and to request reconsideration of DAQ's decision. Following a meeting of the parties, DAQ shall issue a decision letter regarding C8's scavenging coefficients within seven days of the meeting. DAQ reserves the right to require measurement of C8's scavenging coefficients in its decision and DuPont reserves the right to assert a claim of confidentiality in the event such a measurement is made.

d. To the extent that the phases exist, a solid, liquid and vapor phase (T-P) diagram for C8 with respect to pressure and temperature. The temperature and pressure ranges shall be representative of exhaust gas conditions before and after control equipment. Estimates of C8's critical properties shall be provided along with measured ranges of phase transition temperatures.

e. In lieu of a binary phase (T-x-y) diagram representing the vapor-liquid equilibrium between water and C8, the solubility and Krafft Point of C8 in aqueous solutions, measured pK value for C8 dissociation in aqueous solutions, and measurements of C8 concentrations or related acids observed when tested in a head space GC at various concentrations, temperatures, and pHs representative of the ranges observed during actual operating conditions. Furthermore a discussion regarding the volatility of C8 in aqueous solutions as a function of pH will be provided. The information in this paragraph shall be submitted to the DAQ within 60 days of the Effective Date.

f. Henry's law coefficient for C8 and a discussion of its dependence on pH. The coefficient shall be defined at various temperatures covering the range observed during actual operations.

g. Any carbon adsorption data in the form of isotherms for C8 adsorption.

DAQ will provide DuPont an opportunity to comment on modeling methodology and assumptions prior to finalizing the modeling results.

2. Any expenses incurred as a result of accurately supplying the information requested above shall be covered by DuPont.

3. Upon submission of the information required by this Subsection VII.D, DAQ reserves the right to disapprove any data if the analytical methodology or quality control procedures are deemed inappropriate.

VIII. REIMBURSEMENT OF COSTS.

1. DuPont agrees to establish an escrow account to fund Reimbursable Costs under this Consent Order. Expenditures from this account shall be made upon joint approval by a duly designated representative of the WVDEP and of DuPont ("designated representatives"). Written notice of such designation shall be sent to the persons identified pursuant to Section XVI of this Consent Order. Prior to the execution of this Consent Order, WVDEP has provided DuPont with an estimate of Reimbursable Costs that WVDEP expects to incur under this Consent Order.

2. Within 10 business days of the Effective Date, DuPont shall deposit in the escrow account funds in the amount of fifty thousand dollars ($50,000). Each expenditure from the escrow account must be supported by an itemized accounting, including invoices and receipts. Said escrow account shall be replenished with additional funds whenever the balance is less than ten thousand dollars ($10,000), or as agreed to by the designated representatives. Any unexpended amount remaining in the escrow account at the conclusion of the work to be performed under this Consent Order shall be returned to DuPont.

3. DuPont's obligation to pay Reimbursable Costs under this Consent Order shall

not exceed two hundred and fifty thousand dollars ($250,000). Except as to Reimbursable Costs which are addressed separately in this section, all other costs incurred by DuPont in carrying out its obligations under Consent Order shall be the sole responsibility and obligation of DuPont.

IX. QUALITY ASSURANCE/QUALITY CONTROL.

All sampling and analyses performed pursuant to this Consent Order shall conform to EPA guidance regarding quality assurance/quality control, data validation, and chain of custody procedures. The laboratory performing the analyses shall be approved by the Parties prior to sampling.

X. C8 REDUCTION PROGRAM.

1. Notwithstanding current permitted emission levels, DuPont agrees to limit overall C8 emissions to the air to no more than actual calendar year 2000 levels on a calendar year basis and shall further provide to the WVDEP monthly emissions reports regarding C8. The reporting requirement contained herein shall be modified to quarterly reports upon the issuance of a Screening Level derived following the procedures set out in Attachment C.

2. DuPont agrees to reduce emissions to the air and discharges to the water of C8 collectively by 50% from actual 1999 levels by December 31, 2003.

3. DuPont shall operate and maintain the filter and carbon bed treatment system at its Washington Works facility with the goal of achieving 90-95% C8 removal efficiency in its major C8-containing wastewater stream.

4. DuPont shall conduct the following construction projects and abide by the specified dates:

a. DuPont shall install an improved scrubber filter to replace recovery device T6IZC on permit R13-815D. Construction shall begin no later than February 28, 2002. Initial operation shall begin no later than the date of start up after the April shutdown, or June 28, 2002, whichever is earlier.

b. DuPont shall modify the stack for emission point T6IZCE so that the emission point elevation is 170 feet above grade. The stack diameter, velocity, and flow rate shall be sized to provide effective dispersion of particulate emissions according to 45 Code of State Rules, Series 20 (Good Engineering Practice as Applicable to Stack Heights). Construction shall begin no later than February 28, 2002. Initial operation shall begin no later than the date of start up after the April shutdown, or June 28, 2002, whichever is earlier. At times when device T6IZC is not operating, permitted emissions from scrubber T6IFC shall be emitted to emission point

T6IZCE.

5. DuPont shall conduct a scrubber optimization and recovery improvement program that shall consist of a study of scrubber operation for device C2DWC2 on permit R13-614A. The study shall be complete by the end of March 2002. Provided the results are encouraging, the company shall implement identified improvements for this device and similar improvements for units C2DTC2 on permit R13-614A, C2EHC2 on permit R13-1953, and C1FSC2 on proposed permit for R13-2365A. Implementation of the improvements for the latter devices will be complete no later than the end of November 2002.

XI. COMPLIANCE WITH SCREENING LEVELS.

1. The following requirements shall apply only if the procedures set out in Attachment C have been followed:

a. No later than 60 days after receipt of notification from the Agencies that data or information developed pursuant to this Consent Order or other information that is recent and valid demonstrates that DuPont's operations have resulted in C8 exposures above the Screening Levels derived following the procedures set out in Attachment C, DuPont shall submit a plan for review and approval by the Agencies that is designed to reduce such exposures to levels below the Screening Levels within a reasonable time (the "Remedial Plan" or "the Plan").

b. Within 30 days of receipt of the Remedial Plan submitted by DuPont, the WVDEP shall, upon consultation with the WVDHHR-BPH and based upon accuracy, quality, and completeness, either approve or disapprove the Plan. If the WVDEP disapproves the Remedial Plan, the WVDEP shall notify DuPont in writing that the Remedial Plan has been disapproved and shall specify the reasons for such disapproval. DuPont shall resubmit the Remedial Plan as revised to address the deficiencies identified in the notice. DuPont's failure to submit an approvable Remedial Plan shall be deemed a violation of this Consent Order.

2. In the event EPA or the WVDEP develops and finalizes a reference dose/screening level for C8 in accordance with applicable statutory and regulatory requirements ("the Regulatory EPA Standard") that would be applicable to Dupont's activities or the Facilities independent of this Consent Order, DuPont's obligations under this Section shall be determined with reference to the Regulatory EPA Standard. DuPont reserves all rights it may have to comment upon, object to, or appeal the Regulatory EPA Standard in proceedings separate and apart from this Consent Order.

XII. COMPLETION OF CONSENT ORDER.

1. Except as to DuPont's obligations under Section XI, this Consent Order and DuPont's obligations hereunder shall terminate upon issuance of a completion letter(s) from the Secretary of the WVDEP or his designee and from the Commissioner of the WVDHHR-BPH to

DuPont. In a timely manner following receipt of a written request from DuPont the respective Agencies shall issue the completion letter(s) to DuPont or shall issue a letter to DuPont detailing the obligations and work that have not been completed in accordance with this Consent Order. The Parties agree that the Agencies' obligation to issue this letter shall be deemed a non-discretionary duty.

2. DuPont's obligation to achieve and maintain compliance with the Screening Levels as provided in Section XI of this Consent Order shall survive the termination of this Consent Order. Such obligation shall terminate only as provided in Section XI or upon agreement of the Parties.

XIII. ADDITIONAL ACTIONS.

The Agencies, individually or collectively, pursuant to their statutory duty and authority, may determine that additional action, beyond the tasks set forth in this Consent Order, is necessary to protect human health and/or the environment. Nothing in this Consent Order shall be construed as restraining or preventing the Agencies from taking such actions. Nothing in this Consent Order constitutes a satisfaction of or release from any claim or cause of action against DuPont for any liability it may have pursuant to the federal Clean Water Act, the federal Clean Air Act, the federal Safe Drinking Water Act, the West Virginia Groundwater Protection Act, the West Virginia Air Pollution Control Act, other statutes applicable to this matter, or West Virginia common law. Nothing in this Consent Order in any way constitutes a modification or waiver of statutory requirements of DuPont and nothing in this Consent Order shall obligate DuPont to undertake any actions not specified herein.

XIV. ENFORCEMENT.

Enforcement of this Consent Order may be had by the filing of a civil action by any of the Agencies in the Circuit Court of Wood County, West Virginia. Violation of the terms and conditions of this Consent Order by DuPont is a violation of the West Virginia Code and may result in enforcement action being taken, including a request for civil penalties as set forth by law. DuPont shall not be liable for violations of this Consent Order due to any "Force Majeure" condition.

XV. CONTENTS OF CONSENT ORDER/MODIFICATION.

The entirety of this Consent Order consists of the terms and conditions set forth herein and in any attachments or exhibits referenced herein. Modification of the terms and conditions of this Consent Order including any modification of timeframes or deadlines established in this Consent Order shall be made only by agreement of the Parties in writing, except that modifications to any

requirement set out in the attachments to this Consent Order may be made upon consensus of the members of the GIST or the CAT Team, as appropriate.

XVI. ADDRESSES FOR ALL CORRESPONDENCE

All documents, including reports, approvals, notifications, disapprovals, and other correspondence, to be submitted under this Consent Order shall be sent by certified mail, return receipt requested, hand delivery, overnight mail or by courier service to the following addresses or to such addresses DuPont or WVDEP may designate in writing.

Documents to be submitted to WVDEP should be sent to:

WV Department of Environmental Protection
1356 Hansford Street
Charleston, West Virginia 25301

Attention: Armando Benincasa, Esq.
Attention: Dee Ann Staats, Ph.D.
Phone No.: (304) 558-2508

Documents to be submitted to WVDHHR-BPH should be sent to:

WV Department of Health and Human Resources
Bureau for Public Health
815 Quarrier Street, Suite 418
Charleston, West Virginia 25301

Attention: William Toomey, Manager of Source Water Assessment Program
Phone No.: (304) 558-2981

Documents to be submitted to DuPont should be sent to:

E. I. du Pont de Nemours and Company
Washington Works
P.O. Box 1217
Parkersburg, West Virginia 26102

Attention: Paul Bossert
Phone No.: (304) 863-4305

and

E. I. du Pont de Nemours and Company
Legal Department, Suite D-71
1007 Market Street
Wilmington, Delaware 19898

Attention: Bernard J. Reilly, Esq.
Phone No.: (302) 774-5445

XVII. AUTHORIZED SIGNATORIES/NON-ADMISSION.

The undersigned representatives state that they have had full and fair opportunity to review this Consent Order and have had opportunity to allow for their counsel to do the same, and therefore enter this Consent Order freely and with full knowledge of its terms and conditions.

The undersigned do hereby confirm that they have the authority to enter into this Consent Order and have the authority to bind their respective party.

Neither the terms of this Consent Order, nor execution thereof shall constitute an admission by DuPont of any fact or of any legal liability. DuPont expressly reserves all rights and defenses that may be available in any proceeding involving third parties or involving WVDEP and WVDHHR-BPH in any other matter.

This Consent Order may be signed in counterparts and shall be effective upon signature of all the Parties below ("Effective Date").

Entered this 14th day of NOVEMBER 2001, by:

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY:

WILLIAM E. ADAMS, DEPUTY SECRETARY
West Virginia Department of Environmental Protection
1356 Hansford Street
Charleston, West Virginia 25301

Entered this 15th day of November, 2001, by:

WEST VIRGINIA DIVISION OF HEALTH AND HUMAN RESOURCES – BUREAU FOR PUBLIC HEALTH

BY:

DR. HENRY TAYLOR, COMMISSIONER
Bureau for Public Health
West Virginia Department of Health and Human Resources
Diamond Building, Room 702
350 Capitol Street
Charleston, West Virginia 25301

Entered this 15th day of Nov, 2001, by:

E. I. DU PONT DE NEMOURS AND COMPANY

BY:

PAUL BOSSERT, PLANT MANAGER

Attachment A

C8 GROUNDWATER INVESTIGATION STEERING TEAM

A team of scientists shall be assembled to assess the presence and extent of C8 in drinking water, groundwater and surface water at and around the DuPont Washington Works facility, and the Local, Letart, and Dry Run Landfills. The Groundwater Investigation Steering Team (GIST) shall include scientists from WVDEP, WVDHHR-BPH, EPA Region III, and DuPont. DuPont shall fund the GIST via an escrow account as provided in Section VIII of the attached Consent Order ("the Consent Order"). Disbursements from this account shall be authorized jointly by the WVDEP GIST leader, and the DuPont representative, Andrew S. Hartten.

A schedule summarizing key GIST tasks, submittals, start and end dates is provided at the end of this document.

GIST Member Organizations/Representatives/General Functions

WVDEP

David Watkins –Groundwater Protection- GIST team leader; escrow funds disbursement oversight; project management and coordination
George Dasher-advisor and technical review
Dee Ann Staats, Ph.D.-advisor

EPA Region III

Garth Connor-science advisor
Jack C. Hwang – Hydrogeologist
Roger Rheinhart-Environmental Engineer

DuPont

Andrew Hartten-Principal Project Leader/Hydrogeologist-technical review, project management and coordination of field investigation activities; escrow funds disbursement oversight.

WVDHHR-BPH

William Toomey-Manager, Source Water Assessment Program- Bureau for Public Health advisor

GIST Team Objectives and Efforts

The primary objective of the GIST is to efficiently review and direct groundwater and surface water monitoring and investigation activities as prescribed in the Consent Order and in this Attachment. The GIST will utilize a phased approach and employ rapid team decision making toward meeting the requirements in an efficient and timely manner. Unless otherwise directed by the GIST, the tasks outlined below shall be performed by DuPont or its representatives.

The GIST will issue a final report(s) with findings and conclusions regarding groundwater quality in and around the Facilities, and the extent of groundwater contamination in and around the Facilities. The GIST final report shall further make recommendations regarding the need for any further work or actions that need to be taken to assure protection of groundwater quality and human health into the future.

The tasks set forth below and in the Consent Order are the minimum tasks to be performed by DuPont and the GIST pursuant to the Consent Order. Additional tasks may be necessary to assure the goals [full groundwater assessment and C8 impact, plume identification, and receptor identification] of the GIST and the Consent Order are met. Those tasks shall be agreed upon by the GIST.

Key Tasks of GIST

Task A: Groundwater Use and Well Survey/Groundwater Monitoring

- Objectives: Conduct a distance-phased groundwater well and water use survey within a 1-mile (and possibly 2 and 3-mile) radial distance or directionally focused distance of the Washington Works and Local, Letart, and Dry Run Landfills.[1]
- Summary: The phased approach to the water and groundwater well use survey will allow the GIST to focus efforts along established C8 impact transport pathways and cease activities in directions where impacts are not present or where there are minimal concentrations. Data results tables will be generated in a timely manner to allow the GIST to meet, evaluate the data, and determine the next course of action. The GIST will determine when the final groundwater well use survey shall be released.

  DuPont agrees to perform, under the supervision of the GIST and through an agreed-to third party, a groundwater use and well survey identifying and sampling all groundwater wells within a 1-mile radius of the three landfills set forth above and the Washington Works facility. The phased approach may be amended by the GIST should field conditions require, e.g., lack of sampling wells in the 1-mile radius, lack of quality sampling points within the 1-mile radius.

  Sampling shall be performed with the specific purpose of finding and measuring the C8 concentration in water. Should concentrations of C8 found in groundwater wells exceed 1 µg/l within the 1-mile radius, the GIST will determine

1 The water use survey should be in substantially the same format as Attachment B.

whether to expand the well survey to a 2-mile radius, a 3-mile radius, or in a specific direction only. Drinking water wells that measure above 1 µg/l shall be re-sampled at a frequency to be determined by the GIST.

Note: The level of 1 ug/l is utilized in this Consent Order for monitoring purposes only and not as a benchmark for determining risk and this level may be adjusted as determined the GIST in furtherance of the tasks and objectives set forth in this Attachment.

- Timing: The initial well survey within a 1-mile radius of the Facilities will be conducted within 60 days of the Consent Order's Effective Date. Additional well survey activities will be conducted on a schedule to be determined by the GIST.

Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data

- Objectives: Develop and implement a monitoring plan that determines the presence and extent of C8 in drinking water, groundwater, and surface water in and around the Washington Works facility and Local, Letart, and Dry Run Landfills and provide a compilation of all available groundwater/surface water monitoring and hydrogeologic characterization data for each facility, as reflected in Table A-1.
- Summary: The GIST will be tasked with an expedited evaluation of existing historical data and hydrogeologic information in order to prioritize the initial scope of work for continuing groundwater monitoring and any additional investigation activities (e.g., monitoring well installations) required under plume identification. DuPont shall provide all historical data and hydrogeologic information it may have related to the Facilities.
- Timing: Within 30 days of the completion of Task A, the GIST will review all the C8 analytical and facility hydrogeologic information to determine the scope of work for groundwater monitoring and additional investigation. The GIST will then establish a schedule for those activities. It is anticipated that a summary of all historical information for each facility will be submitted to GIST within 60 days of the Consent Order's effective date.

Task C: Plume Identification/Groundwater Assessment

- Objective: Determine the vertical and horizontal extent of any and all C8 impacted groundwater exceeding 1 ug/l or as directed by the GIST, which may determine a lower threshold than 1 ug/l. This task shall also include an assessment of C8 impacted groundwater at Letart Landfill and its impact on the Ohio River and public water supplies along the river.
- Summary: The GIST shall first review historical data and results of Task A to determine an appropriate scope of work. Activities should be prioritized to address groundwater plumes contributing to or with the potential to flow toward off-site receptors, with emphasis on those areas where groundwater is used as a drinking water source.

Upon completion of investigation activities, DuPont shall provide the GIST with predicted groundwater flow and contaminant transport models to assess future plume migration.

- Timing: Upon review of all available information and on a schedule to be determined by the GIST, the GIST will complete an initial evaluation of data to determine and prioritize plume identification.

The timing of the initial phase of plume identification/investigation activities and other activities will be on a schedule established by the GIST. Further investigatory activities needed and agreed to by the GIST to carry out the goals of the GIST shall be performed by DuPont on a schedule established by the GIST.

Modeling

Any and all modeling performed pursuant to this attachment and the Consent Order shall use Groundwater Modeling System, or some other model as approved by the GIST.

TABLE A-1

COMPILATION OF HISTORICAL DATA AND MONITORING PLAN	
a. Dependent upon the availability of certain information, an historical data summary documented in a report that includes:	• A location map. • A site map showing the location of all known groundwater monitoring wells, residential groundwater wells and public water supply within a 1-mile radius the Facilities. • Top-of-groundwater maps. These should span the entire sampling life of the site and should be no less than yearly. If DuPont has only one year's worth of data for a given site, then these maps should be for each quarter; if DuPont has several years worth of data for each site, then these maps can be annual. • C8 concentration contour maps. These should span the entire sampling life of the site and should be no less than yearly. If DuPont has only one year's worth of data for a given site, then these maps should be for each quarter; if DuPont has several years worth of data for each site, then these maps can be annual. • All the C8 groundwater data that has been collected to date. These data should be submitted in easy-to-read tables. These tables should use the method, "<x", to designate all concentrations below the laboratory's minimum detection limit (not "ND" or some other abbreviation), and they should use "mg/" or "µg/" as the unit designation. • If unable to provide the above data, DuPont shall document the reasons why it is unable to gather and submit the information.
b. A groundwater monitoring plan for the Facilities which should address, at a minimum:	• C8 sampling. The samples should be taken from all the wells at the three landfill sites and from a select number of wells at the Washington Works plant. These select wells are to be chosen by the GIST before the groundwater monitoring program begins based on evaluation of historical data/information. The frequency of sampling shall be monthly for the first four months following the Effective Date and quarterly thereafter. Any new wells required for monitoring or plume identification purposes will be integrated in each site's groundwater monitoring program on a schedule agreed to by the GIST.

- Report of Results. Reporting should be quarterly and to the WVDEP Groundwater Program at the following address.

  WVDEP Division of Water Resources
  Groundwater Program
  1201 Greenbrier Street
  Charleston, West Virginia 25311
  Re: DuPont/C8 monitoring.

- Each report should include the following:

  (a) A site location map.

  (b) A site map showing the groundwater monitoring well locations.

  (c) A top-of-groundwater map.

  (d) A C8 concentration map.

  (e) Groundwater elevation and well screen data.

  (f) A table of all the historical C8 sampling data. Note: where available information allows, abbreviations should not be used to designate No Detect concentrations and the units "ppb" and "ppm" should not be used.

  (g) Laboratory analysis sheets.

  (h) Chain of custody records.

Attachment B

GROUNDWATER WELL USE SURVEY

Name: _____

Address: _____
_____
_____

Phone: _____

Best Time to Contact Owner: _____

1. Do you have one or more water well(s) on this property? (It need not be in use currently.) If no, stop now and return survey. Yes _____ No _____

   County Water Well Permit No. _____

2. Is the well(s) currently (circle one) used unused or filled in?

3. Is the well(s) used for drinking water? Yes _____ No _____

4. Is this well(s) used for other purposes? If yes, please specify uses below:

_____
_____
_____
_____

5. What is the approximate frequency of use? Circle One:

   Daily Weekly Monthly Summer

6. Date last used? _____

7. Is there a pump in the well? Yes _____ No _____

8. Is there a conditioner, softener, chlorinator, filter, or other form of treatment for the system? Yes _____ No _____

If so, what is the form of treatment? _____

9. Is there any faucet where water does not first pass through the treatment system?
Yes _____ No _____

If yes, is it (circle one) inside or outside?

10. What year was the well constructed? _____

11. Please provide the following information regarding the well(s) if known: (circle one)

A. Total Depth (feet below ground surface):

30-60 60-90 90-120 120 or more

B. Casing Type:

PVC steel stone none other _____

C. Well Construction:

dug drilled open or uncased bedrock

D. Screened Interval (length in feet):

0-10 10-20 20-30 30-60 60 or more

E. Well Diameter (inches):

0-6 6-12 12-24 24 or more

Attachment C

C8 ASSESSMENT OF TOXICITY TEAM

A team of scientists shall be assembled to assess the toxicity and risk to human health and the environment associated with exposure to ammonium perfluorooctanoate (C8) releases from DuPont's activities. The C8 Assessment of Toxicity Team (CAT Team) shall include scientists from academia, government, non-profit organizations, and industry. The CAT Team also shall include the WVDEP Environmental Advocate, Pam Nixon, as a representative of West Virginia's citizens.

The WVDEP, utilizing funds from an escrow account funded by DuPont, shall contract with a non-profit organization, the National Institute for Chemical Studies (NICS), for the services described herein. Point of contact for the NICS shall be Jan Taylor, Ph.D. The NICS shall subcontract with Marshall University's Center for Rural and Environmental Health for services in risk communication provided by James Becker, M.D. and his staff. Dr. Becker shall familiarize himself with the toxicity of C8, the work performed by TERA as described herein, and attend public meetings to provide expertise in risk communication. The NICS shall subcontract with the non-profit scientific organization, Toxicology Excellence for Risk Assessment (TERA) whose point of contact is Joan Dollarhide, Ph.D. The TERA shall provide services in toxicology and risk assessment. Work assignments, tasks, and deliverables are described below.

CAT Team Member Organizations/ Representatives[1]/ General Functions

WVDEP

Dee Ann Staats, Ph.D. - Science Advisor - team leader; escrow funds disbursement oversight; project management and coordination; toxicology/risk assessment and communication;

Pam Nixon - Environmental Advocate - advisor;

NICS

Jan Taylor, Ph.D. –contractor administrative oversight;

James Becker, M.D. (Marshall University) - consultant in risk communication;

TERA (point of contact: Joan Dollarhide, Ph.D.)- consultant in toxicology/risk assessment;

[1] The parties may, in their discretion, elect to substitute their representatives with persons of similar qualifications.

DuPont

Gerald Kennedy, Director of Applied Toxicology and Health, Haskell Laboratory - reviewer toxicology; escrow funds disbursement oversight;

John Whysner, M.D. – toxicology/risk assessment and communications;

Paul Bossert – Washington Works Plant Manager – communications;

The following members of the CAT Team shall act as reviewers or advisors.

WV Department of Health and Human Resources – Bureau for Public Health (WVDHHR-BPH)

William Toomey – Manager, Source Water Assessment Program - advisor;
Barbara Taylor – Director, Office of Environmental Health Services - advisor;
Local representative - advisor;

Environmental Protection Agency (EPA)

Headquarters - Jennifer Seed – reviewer and advisor toxicology;
Region III Philadelphia -
Samuel Rotenberg, Ph.D. – reviewer and advisor toxicology/ risk assessment;
Garth Connor – advisor hydrogeology;
Roger Reinhart – reviewer and advisor Safe Drinking Water Act;
Cincinnati - John Cicmanec, DVM – reviewer and advisor toxicology;

Agency for Toxic Substances and Disease Registry (ATSDR)

Atlanta - John Wheeler, Ph.D. - reviewer and advisor in toxicology/ risk assessment;
Philadelphia - Lora Werner - coordinator for ATSDR;

Non-CAT Team Efforts

Other efforts are currently underway which may produce information for the CAT Team to utilize. The CAT Team will coordinate and communicate closely with these other efforts. These include:

1. Dupont's air modeling of C8 emissions from the Washington Works plant;

2. WVDEP's air modeling of C8 emissions from the Washington Works plant;

3. USEPA Draft Hazard Assessment which summarizes the available toxicity information regarding C8, to the extent completed prior to the assessment contemplated herein;

4. ATSDR's Health Consultation that estimates the risk to the community associated with C8 in drinking water from the Lubeck Public Service District, to the extent completed prior to the assessment contemplated herein.

5. Existing C8 concentrations in Lubeck Public Service District data.

6. Groundwater C8 Analysis (see GIST activities described in Attachment A) and Well Use Survey (see example survey in Attachment B) at the residences in the area of the 3 landfills and the Washington Works Plant.

Tasks of CAT Team

The tasks to be performed by the CAT Team are described briefly in Table 1, and in more detail below. These tasks are discussed below within the context of a Scope of Work for both Dr. Becker and for TERA as well.

Tasks of the CAT Team shall be organized into three phases. Phase I includes those tasks necessary to prepare for and hold the first public meeting. In Phase II, TERA shall conduct such scientific tasks as: reviewing available toxicity and epidemiological studies; developing Provisional Reference Doses and Screening Levels for protection of human health; evaluating existing information relative to ecological health; and conducting one general risk assessment involving comparisons of exposure concentrations to Screening Levels, for the three landfills and the Washington Works Plant, and the Lubeck Public Service District. TERA shall prepare a report on their findings. Phase III includes those tasks necessary to prepare for and hold the second public meeting. The results of the C8 groundwater analysis and risk assessment shall be presented in the second public meeting.

No communication between Dupont representatives and NICS, Dr. Becker, or TERA shall be permitted without the participation of Dr. Staats. All information will be provided to Dr. Becker and TERA by WVDEP; thus, all information contributed to the effort by Dupont shall be sent in triplicate to Dr. Staats for forwarding to Dr. Becker and TERA.

Phase I TASK A-1: First Public Meeting

Two public meetings are anticipated for this project. The First Public Meeting shall occur in Phase I for the purposes of introducing the CAT Team and other involved parties to the public; relating historical information on previous concentrations of C8 in Lubeck Public Service District water supply; informing the citizens of the ensuing activities; and inviting the public to participate by cooperating with sampling and survey efforts in the Groundwater C8 Analysis and Well Use Survey. In order to prepare for the

First Public Meeting, CAT Team members shall familiarize themselves with the available toxicological information concerning C8.

A CAT Team meeting shall be held immediately prior to the first public meeting to: (1) conduct a site visit to the three landfills and the Washington Works Plant, and surrounding residential areas; (2) discuss the toxicity of C8 and other pertinent data; (3) prepare an agenda for the public meeting; (4) coordinate and prepare for the public meeting. Finally, the First Public Meeting will be held and public questions and comments will be recorded by WVDEP.

TABLE 1. TASKS OF CAT TEAM
Task A: Public Meetings (two meetings are anticipated) **Objective:** to inform the local citizens of the following: (in Meeting #1) intent to perform a groundwater well use survey and analysis for C8; intent to develop Screening Levels; and to ask for their cooperation in conducting the water use survey; and (in Meeting #2) results of survey, chemical analysis, and risk assessment. Note that an interim public meeting may be required should six months pass from the first public meeting and the CAT Team Final Report has not been issued. **Primary Responsibility:** Staats
Task B: Development of Provisional Reference Doses **Objective:** to develop Provisional References Doses for C8 for the inhalation and ingestion (and dermal, if possible) routes of exposure. **Primary Responsibility:** TERA
Task C: Development of Screening Levels Based on Protection of Human Health **Objective:** to utilize the Provisional Reference Doses to develop human health risk-based Screening Levels for C8 in air, water, and soil. Note a determination of the potential carcinogenicity of C8 will be conducted as well. **Primary Responsibility:** TERA
Task D: Ecological Data Review **Objective:** to review available information to determine whether sufficient studies have been performed and data have been collected to develop screening criteria for ecological receptors. **Primary Responsibility:** TERA
Task E: Draft Report and Final Report **Objective:** to present and discuss the results of the above tasks. **Primary Responsibility:** TERA

Phase II Tasks B, C, D, and E Development of Provisional Reference Doses and Screening Levels, and Risk Assessment

In Phase II, TERA shall conduct the toxicological and risk assessment activities. After having reviewed the toxicological information regarding C8 provided by WVDEP, TERA shall co : CAT Team, as coordinated by Dr. Staats, regarding its pr ect. Following such consultation, TERA

shall develop Provisional Reference Doses for C8 for the oral, inhalation, and dermal (if possible) routes of exposure. Then TERA shall calculate Screening Levels for water, soil and air based on the risk factors they have estimated. TERA shall perform one general risk assessment involving comparison of exposure concentrations to Screening Levels for the three landfills and the Washington Works Plant, and the Lubeck Public Service District water supply, that focuses on current risk to human health, including workers and residents. This risk assessment shall include: (1) identification of reasonably anticipated land use, surface water and groundwater use; (2) identification of receptors; (3) identification of exposure pathways; (4) identification of exposure concentrations; and (5) comparison of exposure concentrations to appropriate Screening Levels. TERA shall utilize data obtained from the other efforts discussed above such as air modeling; groundwater C8 concentrations in residential and public wells; residential groundwater well use survey; the USEPA's Draft Hazard Assessment; and ATSDR's Health Consultation (if available). TERA also shall review available information to determine whether sufficient studies have been performed and data have been collected to develop screening criteria for protection of ecological health, particularly aquatic life. TERA shall prepare a draft and a final document that discusses the results of their efforts and summarizes the data utilized from other efforts. As the tasks of the CAT Team and other involved parties' progress, data gaps and research recommendations may become evident. These shall be included in TERA's report as suggestions for further research to elucidate the toxicity of C8.

Phase III Second Public Meeting

The purpose of the Second Public Meeting is to present to the citizenry the results of the efforts of the GIST and CAT Teams including C8 concentrations in groundwater from residential wells and public wells the screening levels and the general risk assessment. Air modeling results of the efforts of WVDEP and Dupont will be discussed also. The WVDEP will address any further actions that may be necessary.

SCOPE OF WORK FOR
JAMES BECKER, M.D.

Dr. Becker is a medical doctor specializing in environmental health at the Marshall University School of Medicine Center for Rural and Environmental Health. He will be assisting the WVDEP in his specialty area of risk communication at the two anticipated public meetings. The specific tasks assigned to Dr. Becker are described below.

Phase I Task A-1: First Public Meeting

Dr Becker will assist in preparation for the first public meeting, and attend the meeting providing expertise in risk communication . He will familiarize himself with the available toxicological data, which will be provided to him by WVDEP, with particular emphasis on the epidemiological studies. Note that the toxicological data already has been summarized in the Draft Hazard Assessment prepared by USEPA. No literature search or document retrieval will be required. Specific subtasks required in Phase I to prepare for the first public meeting are described below:

Subtask 1 – Familiarization with toxicological data provided by WVDEP including but not limited to:

a. 8 compact discs of information provided to USEPA under TSCA by 3M Corp (note only a small portion of this information concerns C8);
b. Draft Hazard Assessment document from USEPA;
c. ACGIH Threshold Limit Value (TLV).
d. Journal articles and other information provided by WVDEP.

Subtask 2 – Attend a meeting prior to the first public meeting to:

a. conduct a site visit of the 3 landfills and the Washington Works Plant, and local residential areas;
b. discuss and prepare an agenda;
c. discuss the toxicology and risks associated with C8 with the other CAT Team members.

Subtask 3 – Attend First Public Meeting

Phase III Task A-2 Second Public Meeting

Dr Becker will assist in preparation for the second public meeting, and attend the meeting providing expertise in risk communication. The following subtasks will be required:

Subtask 1 – Familiarization with the toxicological and risk assessment report prepared by TERA;

Subtask 2 – Attend a meeting prior to the second public meeting to:

a. discuss the toxicology and risks associated with C8 with the other CAT Team members;
b. discuss and prepare an agenda.

Subtask 3 – Attend Second Public Meeting

Note that the second public meeting is assumed to be the final public meeting; however, results of data collection may warrant additional public meetings and an expansion of the Scope of Work.

SCOPE OF WORK FOR TERA

TERA (Toxicology Excellence for Risk Assessment) is a non-profit organization that applies sound toxicological data to the risk assessment process to find common ground between environmental, industry, and government groups. TERA will be providing services in toxicology and risk assessment. TERA scientists will be developing risk factors and screening criteria; and conducting one general risk assessment for the 3 landfills, Lubeck Public Service District water supply and the Washington Works Plant. The specific tasks assigned to TERA are described below.

Phase II Tasks B, C, D, and E: Development of Provisional Reference Doses and Screening Levels, and General Assessment of Risk

Subtask 1 – TERA staff will familiarize themselves with the toxicological data provided to by WVDEP. No literature search or document retrieval will be required. Toxicological data to be provided to TERA shall include but is not limited to the following:

a. 8 compact discs of information provided to USEPA under TSCA by 3M Corp (note only a small portion of this information concerns C8);
b. USEPA Draft Hazard Assessment for C8;
c. Journal articles and other information submitted to WVDEP by DuPont.

Subtask 2 – TERA staff will:

a. identify all possible critical toxicological studies suitable for developing Reference Doses for the oral, inhalation, and dermal (if possible) routes of exposure;
b. outline methodology for developing said Reference Doses and for developing Screening Levels for air, water, and soil based on said Reference Doses corresponding to each critical study identified in subtask 2-a;
c. convene a meeting at the TERA facility in Cincinnati, Ohio, to present their findings in subtask 2-a and 2-b, and consult with CAT Team toxicologists as coordinated by Dr. Staats;
d. finalize Reference Doses and Screening Levels based on recommendations of the CAT Team toxicologists as coordinated by Dr. Staats.

Subtask 3 – TERA shall conduct one general risk assessment for the three landfills and Washington Works Plant, and the Lubeck Public Service District water supply based on current risk to human health. This risk assessment shall include:

a) identification of reasonably anticipated land use, surface water and groundwater uses;

b) identification of receptors;
c) identification of exposure pathways;
d) identification of exposure concentrations;
e) comparison of exposure concentrations to appropriate Screening Levels;

TERA shall utilize the following data in the risk assessment process:

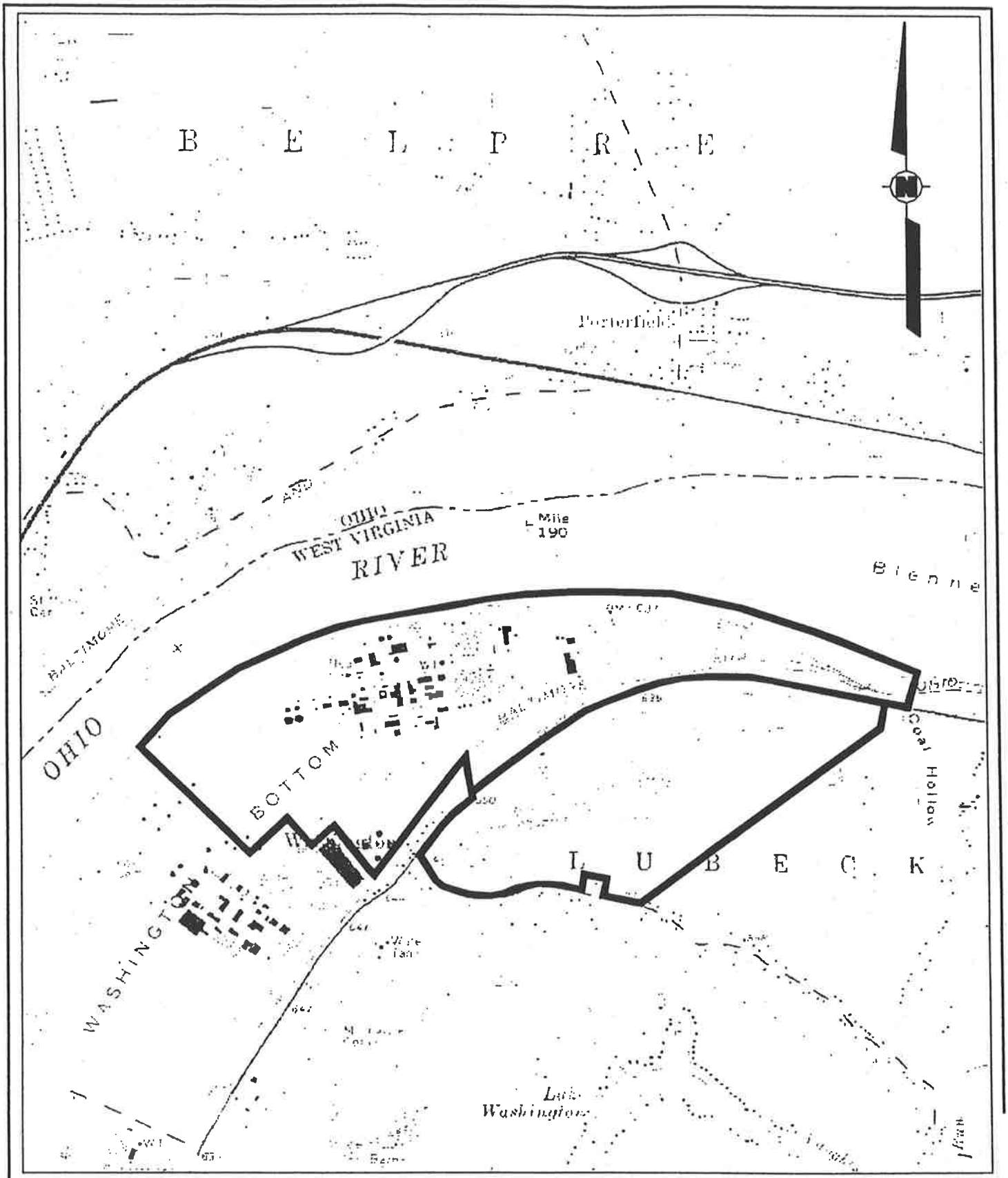
a) air modeling data from DuPont;
b) air modeling data from WVDEP;
c) water use data from the Well Use Survey;
d) groundwater data from the Groundwater Well Analysis of C8 for residential wells;
e) drinking water data from Lubeck Public Service District wells;
f) any available ATSDR Health Consultation that assesses potential health effects from exposure to C8 in public supply drinking water.

Subtask 4 – TERA shall review the ecological data and determine whether there is sufficient information to support the development of a C8 Screening Level for protection of ecological health

Subtask 5 – TERA shall compile and discuss the results of the above tasks into a comprehensive report (draft and final versions), which also refers to and provides a brief summary of the following:

a) USEPA's Draft Hazard Assessment of C8;
b) DuPont's air modeling data;
c) WVDEP's air modeling data;
d) groundwater data from the Groundwater C8 Analysis and Well Use Survey of Local Residents, and Lubeck Public Service District;
e) ATSDR Health Consultation that assesses potential health effects from exposure to C8 in public supply drinking water, if available.

Additionally, TERA shall include in the report any insights or recommendations for future research gleaned during this process that would further elucidate the toxicity of C8. Also, TERA shall provide in the report of a summary discussion of the relevance the carcinogenicity of C8 in rats to humans.



Source: USGS Little Hocking, Ohio – Quadrangle

DUPONT

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

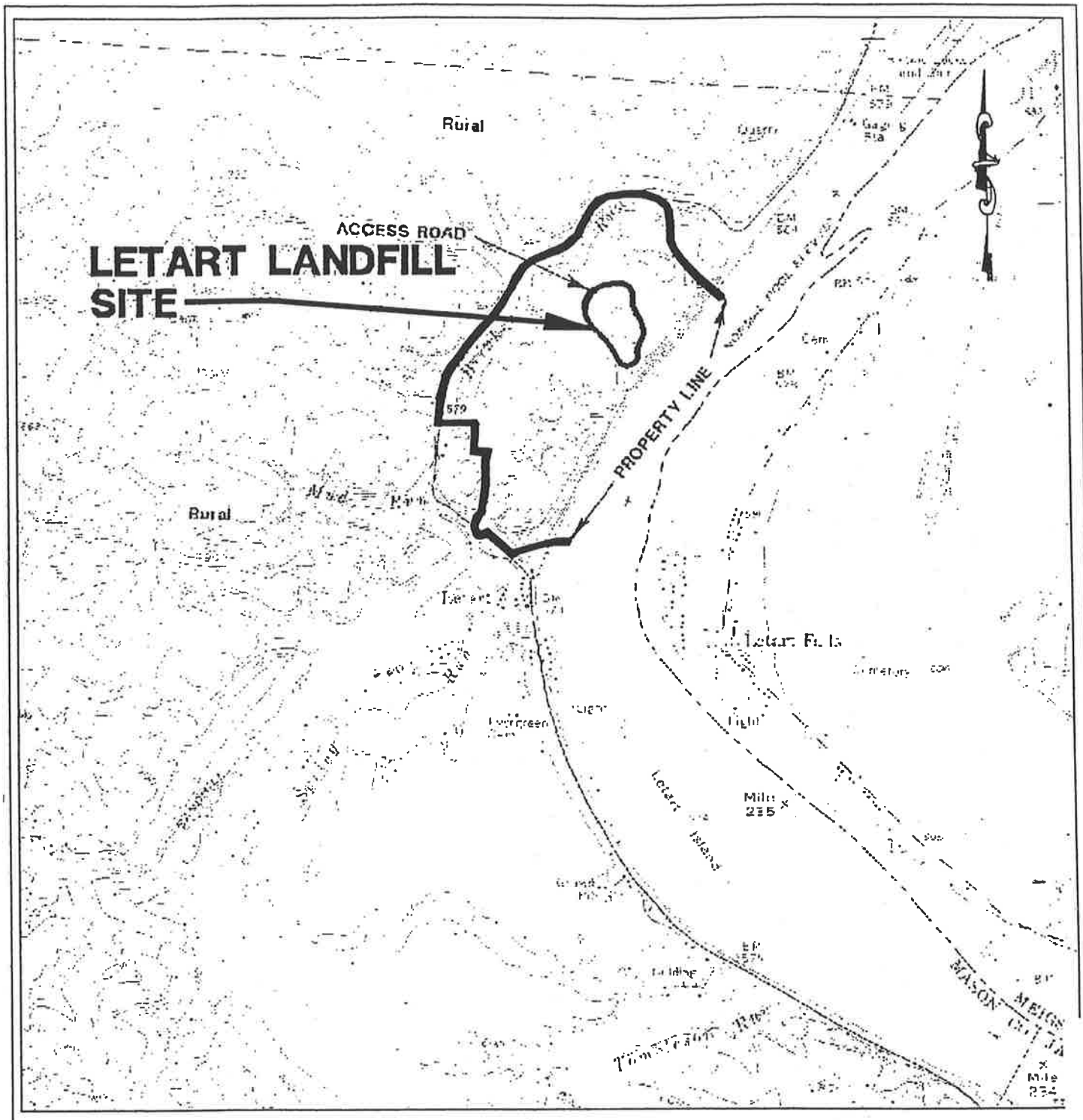
EXHIBIT 1

SITE LOCATION MAP

DuPont Washington Works
Washington, West Virginia

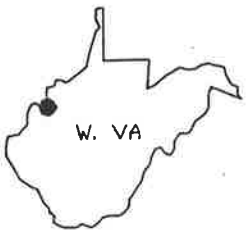
SCALE	DESIGNED	DRAWN	CAD FILE NO.
NA to scale	DEL	DEL	SITE_LOC
DATE	CHECKED	APPROVED	FIGURE
11/27/01	M. HOLLIDAY		1

EPA 01140



SCALE

2000 0 2000'



SOURCE: NEW HAVEN, WV-OHIO QUADRANG

DUPONT

Corporate Remediation Group

An Alliance between DuPont and The E-C Diamond Group

SITE LOCATION MAP

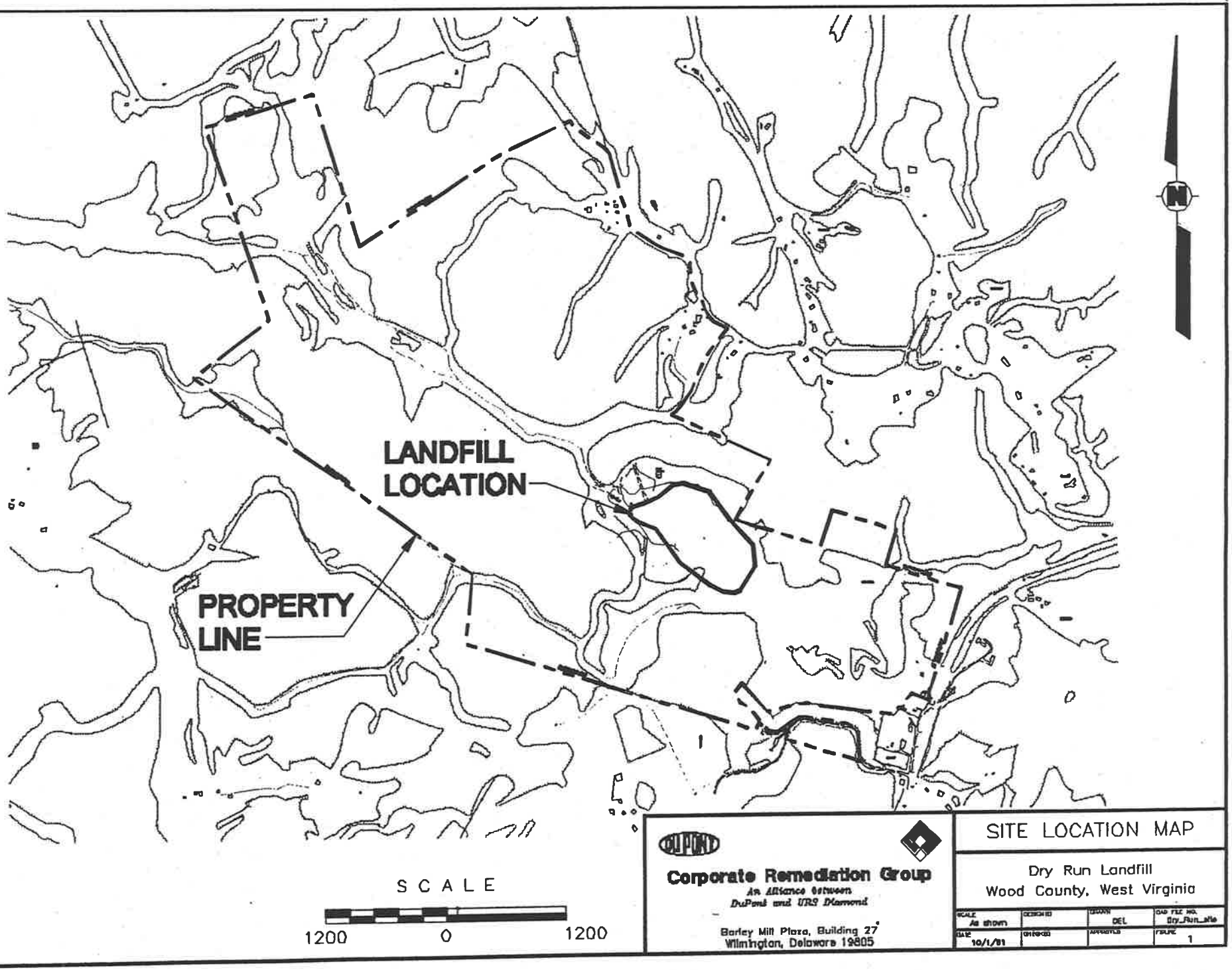
Letart Landfill Site
Parkerburg, WV

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown	TEL	DEL	7264A003
DATE	CHECKED	APPROVED	FIGURE
12/21/0			1

EXHIBIT 2

EPA 01141

EXHIBIT 3



EPA 01142